MACHINERY

Design—Construction—Operation

Volume 43 **MARCH, 1937** **Number 7**

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April MACHINERY — the Annual Automotive Number — will deal with a number of the most recently adopted methods and processes in leading automobile plants. The feature articles will describe a variety of ingenious methods that are applicable in many other branches of the mechanical industries.

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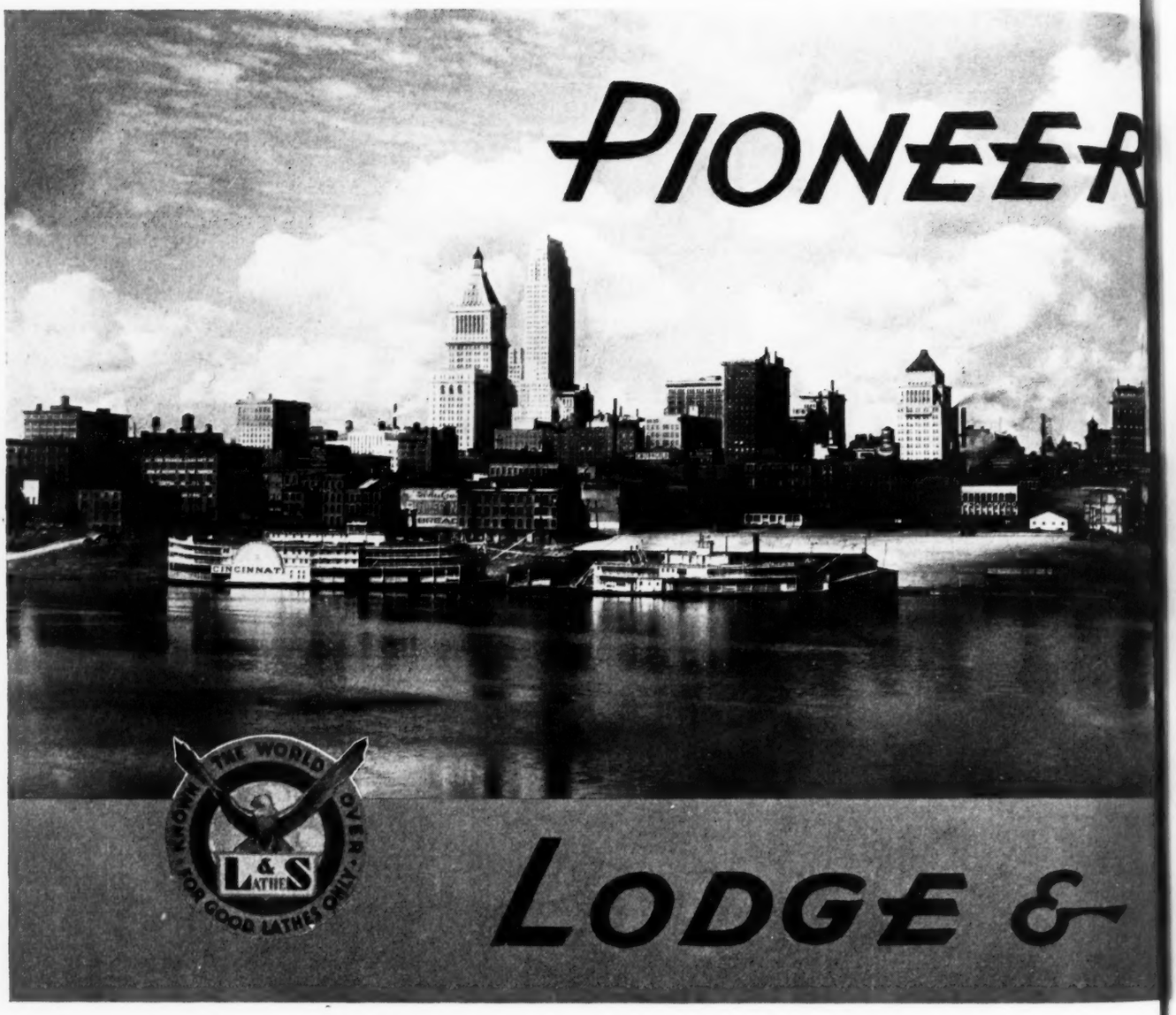

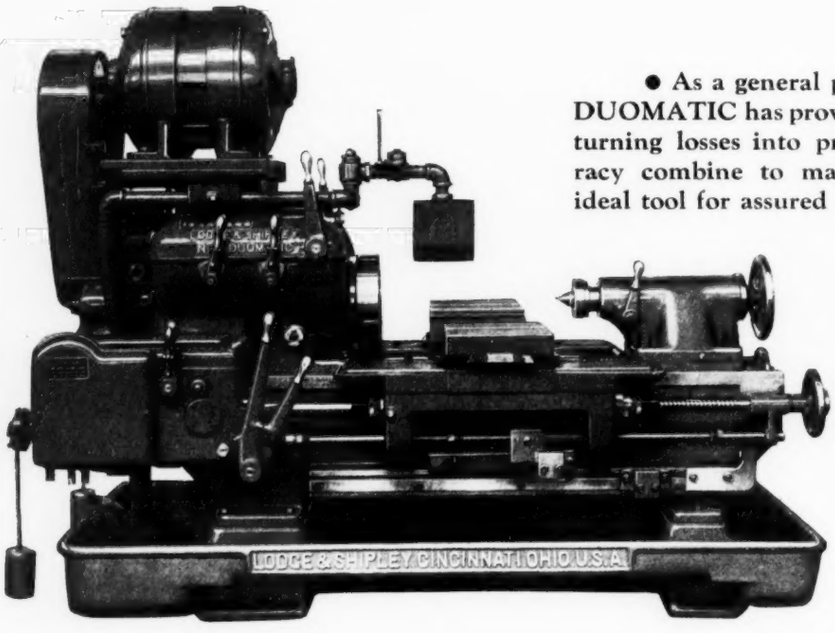

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MACHINERY

Volume 43 NEW YORK, MARCH, 1937 Number 7

Equipment-Buying Formula

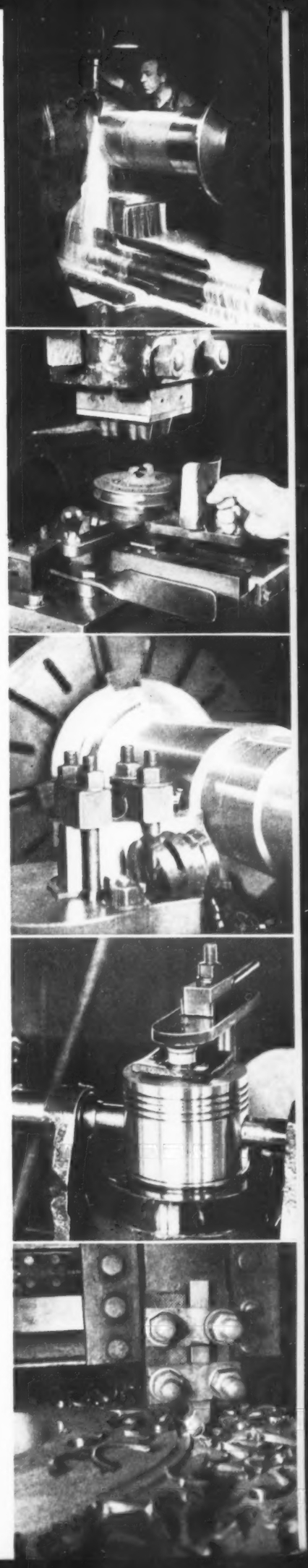
How to Figure the Actual Profits from Investments in Cost-Reducing Tools—or the Actual Losses from the Use of Obsolete Equipment. A Practical Working Formula

EXECUTIVES responsible for manufacturing costs naturally are interested in any new equipment that will save money. In fact, spotting and replacing obsolete equipment is one of the most important jobs connected with plant management. Obsolete equipment works against the interests of everyone and in direct proportion to the amount of such equipment. But how is one to know when equipment is obsolete? Obviously, any manufacturing equipment is obsolete if money can be saved by replacing it. Such equipment may or may not be old; it may or may not be in bad condition. But if its use is the direct cause of actual cash losses, then the equipment is *truly obsolete*.

When a machine is "on its last legs" and no longer can produce work of the required quantity or quality, then the only problem is to find modern equipment suitable for that particular job. But the obsolete equipment that is *apparently* doing its work satisfactorily represents a general class that is often the cause of unsuspected losses. Such equipment, however, is not likely to be replaced unless the profit from a new installation or the loss from further usage of the old can be proved definitely *in terms of dollars*. How can this be done?

Production costs usually consist of two very important items; one is labor costs and the other overhead costs. Changes in labor costs are easily determined, but changes in actual overhead costs are not so easily ascertained. One method that seems to be applied by many plant executives is to reduce overhead charges to an hourly basis. For example, an overhead charge of, say, $1.50 per hour is established as a fair average for a certain shop or department; hence when the installation of a modern machine results in saving a certain amount of time, it is assumed that this machine should be credited not only with the labor saving, but with $1.50 overhead for each hour saved. However, unless the overhead per hour has been established for the particular equipment in question, the results may be very inaccurate.

In a machine shop, one machine tool may cost $1000 and another $20,000. It is evident, therefore, that any attempt to apply the same overhead per hour to both of these machines will give very misleading results. Furthermore, in determining actual dollar savings it is evident that the more efficient equipment should not be given an overhead credit for time saved unless the machine is utilized during that time. This may not be possible, simply be-



EQUIPMENT-BUYING FORMULA

Simple method of determining (1) annual net profit in dollars resulting from replacement of obsolete machines or other manufacturing equipment — or the cost per year of not replacing them; (2) percentage of net profit on investment over and above interest charges on loans or prevailing return on invested capital; (3) number of years required for a profitable installation of new manufacturing equipment to pay for itself out of savings

NOTE: In all formulas, money values are expressed in dollars: For example, if labor cost per piece is 6 cents, write 0.06, and if hourly wage is 70 cents, write 0.70.

$$\text{Annual Net Saving in Dollars} = \left[\begin{array}{l}\text{Labor cost } \textit{Per Piece} \text{ with } \textit{Old} \text{ Equipment (Formula 4)} \\ + \text{Overhead } \textit{Per Piece} \text{ for actual Number of pieces made per year with } \textit{Old} \text{ Equipment (Formula 5)}\end{array}\right] - \left[\begin{array}{l}\text{Labor cost } \textit{Per Piece} \text{ with } \textit{New} \text{ Equipment (Formula 4)} \\ + \text{Overhead } \textit{Per Piece} \text{ for actual Number of pieces made per year with } \textit{New} \text{ Equipment (Formula 6)}\end{array}\right] \times \text{Number of pieces actually made per year with } \textit{New} \text{ Equipment (See Note 1)} \qquad (1)$$

$$\text{Percentage of Net Profit on Investment in New Equipment} = \frac{\text{Annual net saving in dollars} \times 100}{\text{Cost of } \textit{New} \text{ Equipment and of auxiliary fixtures or attachments (See Note 2)} + \text{Unamortized or undepreciated value, if any, of } \textit{Old} \text{ Equipment (Note 3)} - \text{Resale or scrap value of } \textit{Old} \text{ Equipment}} \qquad (2)$$

$$\text{Years required for } \textit{New} \text{ Equipment to Pay for Itself Out of Savings} = \frac{\text{Cost of } \textit{New} \text{ Equipment and of auxiliary fixtures or attachments (Note 2)} + \text{Unamortized or undepreciated value, if any, of } \textit{Old} \text{ Equipment (Note 3)} - \text{Resale or scrap value of } \textit{Old} \text{ Equipment}}{\text{Annual net saving in dollars}} \qquad (3)$$

$$\text{Labor Cost Per Piece, } \textit{Old} \text{ or } \textit{New} \text{ Equipment} = \frac{\text{Number of minutes per piece (per machine if more than one is used)} \div \text{Number of machines used}}{60} \times \text{Number of operators} \times \text{Wage rate per hour} \qquad (4)$$

$$\text{Overhead } \textit{Per Piece} \text{ for Actual Number of Pieces Made with } \textit{Old} \text{ Equipment} = \frac{\text{Depreciation, if any, } \textit{Old} \text{ Equipment, dollars per year (See Note 4)} + \text{Annual interest on undepreciated value, in dollars (See Note 5)} + \text{Annual cost of Power, in dollars (See Note 6)} + \text{Annual machine operating expenses, excepting labor (See Note 7)} + \text{Cost of materials, dollars per year (See Note 8)}}{\text{Actual number of pieces per year from } \textit{Old} \text{ Equipment}} \qquad (5)$$

$$\text{Overhead } \textit{Per Piece} \text{ for Actual Number of Pieces Made with } \textit{New} \text{ Equipment} = \frac{\text{Depreciation, } \textit{New} \text{ Equipment, dollars per year (See Note 9)} + \text{Annual interest on investment, in dollars (See Note 10)} + \text{Annual cost of Power, in dollars (See Note 6)} + \text{Annual machine operating expenses, excepting labor (See Note 7)} + \text{Cost of materials, dollars per year (See Note 8)}}{\text{Actual number of pieces per year from } \textit{New} \text{ Equipment (See Note 1)}} \qquad (6)$$

Note 1—If required production is obtained with part-time operation of new equipment, use the *actual* number of pieces machined or made and not the total production possible. For example, assume that number of parts required annually to meet demand is 2400 and new machine is capable of producing this number in one-half the total time; then insert in formula 2400 and not the total possible production of 4800.

If new equipment can be applied to various jobs, thus reducing or preventing idle time, the annual net saving can be found by inserting in Formula (1) the *average* labor cost per piece and the *average* overhead per piece obtained with the new equipment and also the total number of such miscellaneous pieces produced annually.

Note 2—The total investment includes, in addition to cost of new equipment installed, the cost of fixtures,

chucks, or any auxiliary attachments of a permanent character, but not the cost of cutting or perishable tools which represent a direct operating expense and form part of the overhead cost per piece produced as shown by Formula (6) for overhead.

Note 3—In many cases, machines are *old* as economical producers, but are not old in years and have not been fully depreciated; then the present unamortized or "book value" should be added to the sum invested in new equipment. For example, assume that an old machine cost $3000 and has been depreciated $300 annually. If replacement is being considered at the end of 5 years, the new equipment should show a satisfactory net profit on its own cost plus the $1500 still invested in old equipment capable of doing the work, even though the rate of production may be comparatively low.

Note 4—If old equipment has not been depreciated fully, to obtain annual depreciation, divide present unamortized or remaining value, in dollars, by estimated number of years old equipment can still be used.

Note 5—If old equipment has not been depreciated fully, the average annual interest on the remaining or unamortized value is included in the overhead. (See Note 10 for method of figuring average interest.)

Note 6—Include annual cost of power, in dollars, only if there is an important difference in power cost per piece produced with the old and new equipment.

Note 7—Include annual "setting up" costs, maintenance or repairs, supplies, cost of perishable tools or cutters, only if there is an important difference between these operating expenses per piece produced with the old and new equipment.

Note 8—Include annual cost of material used for product only if there is an important difference between material costs per piece produced with old and new equipment. MACHINERY'S formula is for determining *relative* costs; hence such overhead items as rent, executives' salaries, light, etc., are excluded, because ordinarily they are not changed by the installation of new equipment.

Note 9—To obtain the annual depreciation in dollars, divide the total investment in new equipment by the estimated number of years that the new equipment can be used profitably. The life of a machine may be limited either by obsolescence or by its mechanical condition and may vary from 2 or 3 years to 10 or 15 years, depending upon type of machine, nature of service, care, and general operating conditions. The life of many standard machine tools commonly is assumed to be about 10 years, but special high-duty types may have an estimated life of 5 years or less. In figuring the net profit, if the useful life is assumed to be only 1 or 2 years when a much longer life is justified, the actual profit on the investment will not, of course, be revealed by the calculation.

Note 10—This is the *average* annual interest, in dollars, on the total investment in new equipment during the estimated useful life of that equipment, or interest taking into account annual depreciation. To find average interest, divide 1 plus number of years of life by this number of years, multiply quotient by total investment and multiply product by one-half the prevailing interest rate expressed as a decimal—if 6%, by 0.03, etc. (Use either interest rate paid for borrowed money or rate obtained from conservative investments.) When this average interest item is included, the percentage of net profit shown by Formula (2) is the profit over and above the interest charges.

---

cause full-time operation would result in a greater production than required.

What the shop owner and plant manager wants to know is this: How much actual money will be saved by a proposed replacement of equipment? Expressed differently, how much will the cost of making a given product be reduced? In answering these questions, it is preferable to use cost figures that are directly related to the product itself, and in placing the question of equipment buying upon a dollars-and-cents basis, we must consider two main factors: (1) The effect of a new or proposed installation upon labor costs; (2) the change in actual production costs due to changes in overhead resulting from the new or proposed installation. The rule or formula used to determine these overhead changes must allow for whatever time, if any, the new equipment is idle, as when full-time operation is not required.

MACHINERY'S Equipment-Buying Formula

Savings directly due to the installation of new equipment of the latest design or type often vary from hundreds to thousands of dollars yearly, even from a single machine. Wherever any such savings are possible, it is evident that a careful check is worth while, even though this may put a big dent in the day of the plant's highest-salaried executive.

A formula is given on the preceding page for figuring the net profit resulting from the replacement of equipment which has become obsolete as a producer. Anyone can use this formula for estimating, with reasonable accuracy, either the percentage of net profit, or, if preferred, the length of time required for a new machine or tool to pay for itself. In presenting this formula, no claim is made for originality. An effort has been made, however, to establish a formula that is clearly expressed and simple enough to be applied readily, without excluding factors that might decidedly affect the final result. A formula containing every conceivable factor may be theoretically correct, but of little or no practical value because it includes certain items difficult to determine and not required in a practical estimate of the *relative* production costs with an obsolete and a new or proposed installation.

MACHINERY'S formula is intended more particularly for the mechanical industries, although it may be applied in many different types of manufacturing plants. Unfortunately, total net savings cannot always be determined merely by considering the amounts directly traceable to more efficient production. This is particularly true when some new machine, or, perhaps, an entirely different method of manufacture, results in a decided improvement in the quality of the work, possibly with little or no change in rate of production. Such an improvement in quality may lead to savings either by reduction in work connected with the assembling department or in various other ways. As a general rule, savings due to quality improvement cannot be traced, although an example will be given in a coming number of MACHINERY of savings known to be due chiefly to a more accurate job.

The Starting Point in Working Out the Production-Cost Problem

In dealing with the relative costs of manufacturing a certain machine part, it is essential to know the approximate number required in a given time (annually or monthly). This number may be based upon past experience or estimated on the basis of future sales. Suppose 100,000 duplicate parts are required annually and this number is being produced with the present equipment, but the development of a new machine, a new cutting alloy, or an entirely different process makes it possible to reduce the production time considerably. When a case of this kind arises, the works manager is interested in one question: How much will the new equipment save in actual dollars? Expressed differently, in how many years will the new equipment pay for itself?

Assume that the new equipment will reduce the time per piece one-half, or, if desired, double production. Moreover, assume that the old equipment is meeting requirements, as far as annual production and quality of work are concerned; then the problem is to determine if the new machine will yield a satisfactory return when only half of its time is required on this particular job. This leads to another important point: Is the new machine to stand idle the remaining half of its time or can it be used during part or all of its idle period on one or more other jobs? In some cases, an efficient new machine may stand idle during a considerable part of the time and still yield an attractive return on the investment. In other cases, this is not true. MACHINERY'S formula compensates, or makes allowance, for idle time, if any, in cases where the required production can be obtained with part-time operation.

Example Illustrating Application of Equipment-Buying Formula

In order to show just how a plant owner, works manager, or shop superintendent would use MACHINERY'S formula in figuring the net return from a replacement of obsolete equipment, the following example will be used: The average annual production of duplicate parts for a certain machine is 22,400. Prior to the installation of new equipment, two machines and two operators were required for machining these parts. The average machining time on each of the old machines was 12 minutes per piece; hence, the total production of the two machines is 10 pieces per hour. These old machines have been used twelve years and have been fully depreciated.

The representative of a machine tool builder comes along. His machine will produce the same pieces at an average rate of one minute per piece, increasing the production from 10 to 60 pieces an hour. The new machine will cost $6400 installed, and in this particular case, it will remain idle five-sixths of the time, because the required annual production is obtained in one-sixth of the time and there is no other work for the new machine. Notwithstanding this fact, the salesman claims that the plant owner is actually losing about $1800 in cold cash every year by not spending $6400 for a new machine. And the salesman is not forgetting that this shop owner must borrow the $6400 and pay the bank 6 per cent for it. Let us see now if the salesman is right about the $1800 yearly saving.

Data Required in Determining the Possible Profit from the New Installation

In applying part (1) of MACHINERY'S equipment-buying formula, the first item required is the labor cost per piece with the old equipment. This unit cost is found by using part (4) of the formula. The wage rate per hour is $0.70 and there are two operators.

$$\text{Labor cost per piece with old machines} = \frac{12 \div 2}{60} \times 2 \times 0.70 = \$0.14$$

The next item is the overhead or burden per piece produced. Since the object is to ascertain *relative* costs, all overhead items affecting the old and new machine alike (or nearly so) are excluded, as explained later.

In this case, the cost of power, the general operating expenses, and other items in part (5) of the formula are practically the same per piece produced on the old and new machines; moreover, the two old machines have been fully depreciated. The overhead, then, for the old machines can be ignored, since the object is to find merely the actual saving in dollars.

The next item is the labor cost per piece with the new machine, which requires one operator. Again using part (4) of the formula and a wage rate of $0.70 per hour,

$$\text{Labor cost per piece with new machine} = \frac{1}{60} \times 0.70 = \$0.01166$$

Now let us find the overhead per piece with the new machine (part 6 of formula). The chief item of overhead that concerns us is the annual depreciation. In this particular case, assume that the machine will have a useful life of eight years. This means that we should not make an unreasonable demand and expect the machine to pay for itself in one year or two years, when there is every reason to believe that it will produce economically for at least eight years. The cost of the new machine is $6400, and annual depreciation in this case equals $6400 \div 8 = \$800$ per year.

The average annual interest (allowing for the annual depreciation of $800 and 6 per cent interest on the bank loan) is found as follows (see part 6 of formula and foot-note 10):

$$\text{Average interest} = \frac{8 + 1}{8} \times 6400 \times \frac{0.06}{2} = \$216$$

The other items in the numerator of the overhead formula (part 6), such as cost of power, etc., are practically the same per piece produced on both old and new machines and are not needed. We have then:

$$\text{Overhead per piece when using new machine} = \frac{800 + 216}{22400} = \$0.045$$

We now have all of the cost items required to place the proposed installation right down on a money-saving basis.

The Machine Tool Salesman was Right

Suppose we find out first how much actual cash the new machine will save every year. Part (1) of the formula gives this figure:

$$\text{Annual net saving in dollars} = (0.14 + 0) - (0.01166 + 0.045) \times 22400 = \$1867$$

This saving would, of course, be greater if part or all of the idle time of the new machine (five-sixths of the total in this particular case) could be utilized.

Expressed as a percentage, how much will the new machine earn over and above the 6 per cent paid to the bank? To get this percentage, use part (2) of the formula. The old machines have no unamortized value and their scrap value is $150.

$$\text{Percentage of net profit} = \frac{1867 \times 100}{6400 - 150} = 30 \text{ approx.}$$

Thirty per cent! Where can money be invested safely to yield even one-fifth of this amount? And yet actual examples obtained by MACHINERY (to be presented in forthcoming issues) show even more attractive returns.

Let use see now how many years will be required for the new machine to pay for itself out of savings. Using part (3) of the formula,

$$\text{Years required for new machine to pay for itself} = \frac{6400 - 150}{1867} = 3.3 \text{ years}$$

Overhead Items Used in Determining Relative Production Costs

In determining production costs, the procedure can be simplified greatly by omitting all overhead cost items which are neither increased nor decreased by the new installation. The problem is to determine how much the production cost would be changed by using new equipment. In finding this difference in production costs between the old and the new equipment, it is not necessary to determine the total or absolute costs, which include every item of overhead. The total cost of production contains such items as executives' salaries; building depreciation; insurance; cost of light, heat, and other items, some of which are difficult to determine and to apportion to a given job. Moreover, such cost items are not changed, as a rule, by the replacement of an obsolete machine, and they may be excluded from a practical formula intended merely to determine the *relative* costs and savings.

In many cases, expense items directly connected with the operation of new and old equipment do not differ sufficiently to include them in a formula for determining actual savings. For example, if the amount of power for driving the new machine is practically the same as for the old one, the power cost may be ignored, especially when the new machine produces the same total quantity of work as the old one, but in less time. The same principle applies to general supplies, perishable cutters, cutting compounds, and materials used for the product, provided there is little or no change in the cost of these various items.

The important overhead items are the annual charge for the depreciation of the new equipment and the interest on the investment. In many cases, these two items of overhead added to the labor cost give a cost figure sufficiently accurate for a practical comparison with another machine or class of equipment. Authorities differ concerning the inclusion of interest as a cost item. When new equipment is purchased with borrowed money, the interest on the loan appears to be very much of a cost item; however, in comparing production costs with old and new equipment, interest may or may not be included as a cost item. It is important, however, to have clearly in mind just what has been done in this connection. In MACHINERY'S formula the average interest on the investment (allowing for annual depreciation) is included in the cost; consequently, when the formula shows a net return on the investment of, say, 25 per cent, this means 25 per cent *over and above both depreciation and average interest charges.*

In MACHINERY'S formula, the costs are related directly to the product itself, since the sole object is to determine the amount of money actually saved in production costs when one machine or process is substituted for another. While there are several other methods of applying overhead, the *per-piece* method appears to be the most direct and accurate one in a practical formula for determining relative production costs. While the cost per piece is called for by the formula, it will be understood that any unit quantity may be used instead. For example, if the problem is to determine the relative costs in producing small parts in large quantities, the cost per hundred or per thousand might be inserted in the formula instead of the cost per piece to avoid using very small unit cost figures.

How Long Should a Machine Live?

Some machines can be used almost indefinitely, especially if no one discovers the cost of keeping them on the job. The time to scrap a machine is when it is *uneconomical to use it longer.* Establishing the life of a machine in years, or a depreciation percentage, is complicated by reason of the fact that many machines are *old as producers* before they are *old in years* and while they are still

in excellent physical condition; consequently, a machine sometimes becomes obsolete because a new or improved type or process has been developed.

A life of ten years or a depreciation of 10 per cent is a common estimate for equipment in the mechanical industries; however, a life of five years or 20 per cent depreciation is more accurate for many classes of machine tools, and depreciation may range as high as 30, 50, or even 100 per cent, depending upon the type of machine, the extent of its use, and service conditions. Standard machine tools, especially certain very large types that may only be used occasionally, should have relatively low depreciation percentages.

In figuring net savings from the installation of new equipment, the amount charged against a new machine for annual depreciation is, of course, a very important item in determining costs; hence, the estimated life should have a reasonable basis. For example, if, in estimating the probable yield on an investment in new equipment, the life is assumed to be two or three years when it should be five or possibly ten years, the great increase in overhead may discourage the plant owner or executive from installing equipment that would have resulted in an attractive saving.

In determining the actual yield from a replacement of obsolete equipment, the true depreciation (as nearly as this can be estimated) should always be used, even though it may differ from the amount allowed by the government in computing taxes.

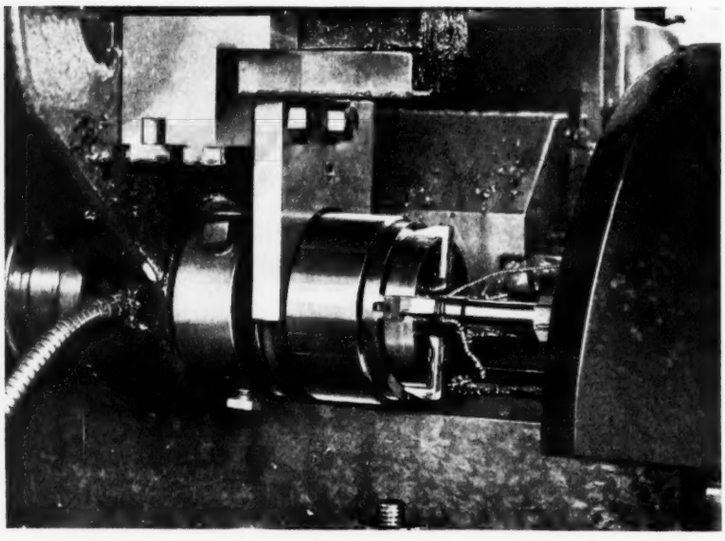
The depreciation of old equipment, or its so-called "book value," should be taken into account, especially if there is considerable undepreciated value. If a machine purchased five years ago for $3000 has been depreciated at the rate of 10 per cent, its present undepreciated value of $1500 is an item that should be included in the investment in determining relative costs between the old and the new equipment. In a great many cases, however, old machines that could be replaced profitably have been fully depreciated and no longer have an undepreciated value; hence, in estimating relative production costs, only their resale value (either as scrap or as used machines) is taken into account.

How Many Obsolete Machines are Eating up Your Profits?

The object in publishing the equipment-buying formula is to place in the hands of managers of shops and plants throughout the mechanical industry a practical means of checking for themselves the savings that might result from investments in new machines; or, to reverse the viewpoint, the formula will show *how much is being lost annually by not making investments in up-to-date tool equipment.*

Equipment replacement may result in surprisingly large savings and superficial checking will not do. Equipment replacement is a matter of relative production *costs* and not relative machine *ages.* Machines should not be condemned merely because they have been used for a certain number of years; on the other hand, it is unsafe to assume that all quite new machines are economical.

The replacement of machines can be justified only by the net saving in dollars resulting from such replacements. While all old equipment should be checked to safeguard against profit leaks, it is well to remember that some very profitable investments result from the substitution of brand new developments for machines that are *quite new in years* and in excellent physical condition, but *old in terms of production costs.* Deciding when to replace manufacturing equipment is a question of actual dollars saved. Every manufacturer buys raw materials in order to profit by increasing their value through manufacturing processes. If the same or larger net profits per dollar can be secured by investing in more efficient means of production, that is plain common sense applied to spending.



Threading bolts made from Union Super-cut screw stock with a 1-inch Style KD Geometric Tool Co.'s rotary self-opening die-head on a 1 3/4-inch Gridley multiple-spindle automatic in the Albert Wright plant in San Francisco. Threads, 3/8 inch straight pipe, 13/16 inch long; pitch-diameter tolerance, 0.002 inch; lead tolerance, 0.0015 inch; production (all operations), 65 an hour; 14,000 pieces made without touching chasers.

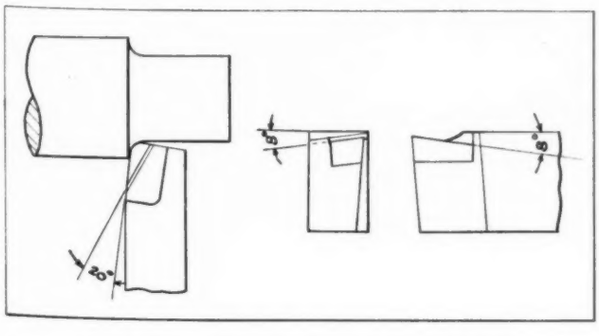
Breaking up the Chips in Machining with Tantalum-Carbide Tipped Tools

Outline of a Method for Effectively Breaking up the Chips when Machining Steel at Speeds of from 200 to 300 Feet per Minute

By PHILIP M. McKENNA, Vice-President
Vanadium-Alloys Steel Co., Vascoloy-Ramet Division
North Chicago, Ill.

TANTALUM-CARBIDE tipped tools are especially adapted to turning steel at high speeds. One of the problems met with in high-speed turning is the rapidly formed continuous chips. Since it is not generally known how readily chips turned at from 200 to 300 feet per minute can be broken into convenient sized lengths by means of the nose shapes to be described in this article, it is believed that this information will prove of value in the machine shop industries.

Assume that smooth bars of S A E-3140, a tough chrome-nickel steel, are to be machined with a conventionally shaped tipped tool with plane surface and having, say, an 8-degree side rake and no back slope. The cutting speed is 225 feet per minute, the feed 0.014 inch per revolution, and the depth of cut 1/4 inch. The reduction of 1/2 inch in diameter of a 3-inch bar produces long unbroken chips of great toughness; yet by a very simple change in the tool shape, these chips are broken up in pieces 1/2 to 1 inch long, which are readily shoveled up from under the lathe. The shape of the nose required to do this is shown in the diagram. The halftone illustration shows the chips produced with a tool having the top surface ground in this way.



Tantalum-carbide Tool Ground with a Small "Groove" Acting as Chip Breaker

Since the wear of tantalum-carbide tools is about one-fiftieth that of ordinary tool materials, obviously a large number of pieces can be machined per grind. Tantalum carbide does not adhere to steel, and hence "cratering" or top wear does not occur. When necessary to regrind the tool, the shape is easily maintained. In turning with tantalum-carbide tools, less heat is generated than with other tool materials, as there is less friction. Consequently, it is preferable to operate without coolant or lubricant, especially since the coolant as ordinarily applied does not actually come in contact with the cutting surface, and therefore, when the cut is finished and the tip is exposed to the coolant, there is danger of cracking it because of the sudden change in temperature.

Recent increases in the breaking strength of tantalum-carbide tool materials have made possible the use of greater rake and clearance angles than were previously customary with hard carbide tools. This has increased the cutting efficiency. The hardness of different grades of tantalum-carbide compositions varies from 87 to 92 Rockwell A, with corresponding strengths ranging from 403,000 to 185,000 pounds per square inch in transverse rupture tests. These hard compositions are especially suitable for cutting steel in turning, facing, boring, and precision boring operations; they are also characterized by their resistance to corrosion and acids. In addition, there are the low-percentage tantalum-carbide compositions used for machining cast irons, particularly malleable iron and alloyed iron. Probably the stable surface characteristics are responsible for the non-cratering property when the tools are used for cutting steel.

The chip-breaking shape of nose is, of course, unnecessary in many operations where only a light cut is taken, where a forged surface is sufficiently uneven to break the chips, or where intermittent or broken cuts are taken. The greater rake angles used on annealed steels are not necessary when very hard steels are turned—up to 500 Brinell—which is now being done commercially in many plants with tantalum-carbide tools. In fact, in such service, even negative back slopes are employed, especially for intermittent cuts.

With modern high-speed lathes, possessing sufficient rigidity, such as are now available on the market, steel can be turned by tools as described in much less time than required with previously known tool materials.

Gear-Hobbing Celebrates Fiftieth Anniversary

By S. M. RANSOME
Barber-Colman Co., Rockford, Ill.

THIS year the gear-hobbing process enters on its fiftieth year of practical application. It was in 1887 that G. B. Grant applied for a patent on a spur and spiral gear-hobbing machine, which patent was issued in January, 1889, at which time a machine was built that made gear-hobbing a practical process. The principle of gear-hobbing, however, had been thought of previously. In 1856, Christian Schiele had discovered the fundamentals of the process and obtained a patent; but, as far as is known, no one ever made hobbing machines under this patent.

Hobbing was used at first in the production of worm-gears. These gears were gashed on some form of milling machine, and then the teeth were finished to shape by the use of a hob which was placed in engagement with the roughed-out teeth and not only finished the teeth but furnished the drive for the work at the same time. This method will produce surprisingly accurate results if the teeth are spaced accurately in the roughing operation and the gashes are milled so as to leave as little stock as possible for the hob to remove.

In 1897, H. Pfauter further developed the design of the hobbing machine and incorporated a differential mechanism. Since then, numerous improvements have been made in the design and construction of the machine, but always utilizing the original fundamental principles.

From that time on, the development of hobbing has been rapid and its field of activity has been broadened. In the production of spline shafts with straight and spiral splines, this method is practically universally used. Owing to the constant raising of standards of accuracy and quietness in gearing, the hobbing method has been adopted in many different industries to an increasing degree. Hobbing machines are now in operation on such diverse parts as clock, instrument, and fishing-reel gears, on the one hand, and turbine reduction gears on the other. The latter gears transmit thousands of horsepower and run at pitch-line velocities of from 12,000 to 15,000 feet per minute. They are among the finest specimens of gear engineering and manufacture so far available.

Doubtless one of the chief reasons for the success of the hobbing method is the continuous rotative motion of the work and hob. This enables high standards to be set, both for production and for accuracy, and also insures long life of hobbing machines and freedom from major repairs.

Although the whole field of gear production forms a comparatively minor section of the metal-working industry, being slightly under 1 1/2 per cent, measured by the number of machines in use, its importance is great, since practically all machinery uses gears in one place or another. However in this limited field, the hobbing machine has established a place of importance for itself, over 7000 machines being in use in this country alone.

The hobbing process is continuously advancing. New refinements in design, tending to more trouble-free operation, higher speed, greater ease and convenience of operation, and better appearance, are incorporated in machines new being developed.

* * *

"Cutting of Metals" Handbook

At a meeting of the Metropolitan Section of the American Society of Mechanical Engineers, to be held March 2, R. C. Deale will describe the recent activities of a special research committee of the Society which has been at work for four years on an extension of the pioneer work of Frederick W. Taylor on the cutting of metals. Mr. Deale is executive secretary of the committee, and L. P. Alford chairman. The results of this research will soon be published in a "handbook on metal-cutting."

The information that forms the basis for the proposed handbook on metal cutting has been drawn from many sources. It is based partly on research work made for the committee at the Stevens Institute of Technology and partly on data contributed by many of the largest and most progressive shops throughout the country. The text of the proposed book has been prepared by Mr. Deale and carefully revised by him in cooperation with the members of the committee.

MACHINERY'S DATA SHEETS 341 and 342

AMERICAN STANDARD HOSE COUPLING SCREW THREADS—1

Introduction

The purpose of this specification is to provide a standard which will be recognized and adopted at once by a majority of manufacturers and consumers and toward which the minority may be brought, thus eliminating many threads now in use and the confusion and misunderstandings that now prevail.

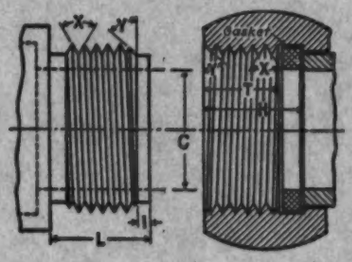
As in the case of other products current practice in use and manufacture must be recognized as well as the specific advantages of certain thread proportions for specific uses. This prevents the adoption of a single specification for each one of the nominal sizes.

These standards apply to the threaded parts of hose couplings, valves, nozzles, and all other fittings used in direct connection with hose intended for fire protection or for domestic, industrial, and general service in nominal sizes of 1/4, 3/8, 3/4, 1, 1 1/4, 1 1/2, and 2 inches.

Basic Thread Dimensions

Service and Nominal Size	Number of Threads per Inch	Outside Diameter of Nipple Thread (Max)
Garden and Similar Hose		
1/2, 3/4, 3/4	11 1/2	1.0625
Chemical Engine and Booster Hose		
3/4, 1	8	1.3750
Fire Protection Hose		
1 1/2	9	1.9000
Steam, Water, Air, Oil, and All Other Hose Connections		
1/4	14	0.8248
3/8	14	1.0353
1	11 1/2	1.2951
1 1/4	11 1/2	1.6399
1 1/2	11 1/2	1.8788
2	11 1/2	2.3528

All dimensions given in inches.



Length of Thread for Hose Couplings and Nipples

Service and Nominal Size	Threads per Inch	Length of Nipple L	Depth of Coupling H	Thread Length for Coupling T	Length of Pilot I	Inside Diameter of Nipple C	Approx. Number of Threads in Length "T"
Garden 1/2, 3/4, 3/4	11 1/2	9/16	17/32	3/8	1/8	31/32	4 1/2
Chemical 3/4, 1	8	5/8	19/32	15/32	5/32	1 1/32	3 3/4
Fire 1 1/2	9	5/8	19/32	15/32	5/32	1 17/32	4 1/4
Other Connections 1/4	14	1/2	15/32	5/16	1/8	17/32	4 1/2
3/8	14	5/8	17/32	3/8	1/8	41/64	5 1/2
1	11 1/2	5/8	17/32	3/8	5/32	1 5/32	4 1/2
1 1/4	11 1/2	5/8	17/32	7/16	5/32	1 1/2	5
1 1/2	11 1/2	5/8	17/32	1 7/32	5/32	1 7/32	6
2	11 1/2	3/4	21/32	1 7/32	3/16	2 1/32	6 1/4

All dimensions given in inches.

Thread and chamfer angles: "X" equals 60 deg; "Y" equals 35 deg.

MACHINERY'S Data Sheet No. 341, New Series, March, 1937

Approved by American Standards Association, July, 1935

AMERICAN STANDARD HOSE COUPLING SCREW THREADS—2

Thread Dimensions

Basic Thread Form Is American National Standard, Having an Included Angle of 60 Deg and Truncated Top and Bottom

Coupling

Service and Nominal Size	Threads per Inch	Pitch	Depth of Thread	Major Diam Min[1]	Pitch Diameter Max	Pitch Diameter Tol	Pitch Diameter Min	Minor Diameter Max[2]	Minor Diameter Tol	Minor Diameter Min
Garden[3] 1/2, 3/4, 3/4	11 1/2	0.08696	0.05648	1.0725	1.0245	0.0085	1.0160	0.9765	0.0170	0.9595
Chemical 3/4, 1	8	0.12500	0.08119	1.3570	1.3169	0.0111	1.3058	1.2468	0.0222	1.2246
Fire 1 1/2	9	0.11111	0.07217	2.0250	1.9460	0.0111	1.9236	1.8769	0.0222	1.8577
Other Connections[3] 1/4	14	0.07143	0.04639	0.8323	0.7929	0.0070	0.7859	0.7535	0.0140	0.7395
3/8	14	0.07143	0.04639	1.0428	1.0034	0.0070	0.9964	0.9640	0.0140	0.9500
1	11 1/2	0.08696	0.05648	1.3051	1.2571	0.0085	1.2486	1.2091	0.0170	1.1921
1 1/4	11 1/2	0.08696	0.05648	1.6499	1.6019	0.0085	1.5934	1.5539	0.0170	1.5369
1 1/2	11 1/2	0.08696	0.05648	1.8888	1.8408	0.0085	1.8323	1.7928	0.0170	1.7758
2	11 1/2	0.08696	0.05648	2.3628	2.3148	0.0085	2.3063	2.2668	0.0170	2.2498

Nipple

Service and Nominal Size	Threads per Inch	Pitch	Depth of Thread	Major Diameter Max	Major Diameter Tol	Major Diameter Min	Pitch Diameter Max	Pitch Diameter Tol	Pitch Diameter Min	Minor Diam Max
Garden[3] 1/2, 3/4, 3/4	11 1/2	0.08696	0.05648	1.0625	0.0170	1.0455	1.0060	0.0085	0.9975	0.9485
Chemical 3/4, 1	8	0.12500	0.08119	1.3750	0.0222	1.3528	1.2838	0.0111	1.2727	1.2126
Fire 1 1/2	9	0.11111	0.07217	1.9000	0.0222	1.8678	1.8178	0.0111	1.8067	1.8457
Other Connections[3] 1/4	14	0.07143	0.04639	0.8248	0.0140	0.8108	0.7784	0.0070	0.7714	0.7330
3/8	14	0.07143	0.04639	1.0353	0.0140	1.0213	0.9889	0.0070	0.9819	0.9425
1	11 1/2	0.08696	0.05648	1.2951	0.0170	1.2781	1.2386	0.0085	1.2301	1.1821
1 1/4	11 1/2	0.08696	0.05648	1.6399	0.0170	1.6229	1.5834	0.0085	1.5749	1.5269
1 1/2	11 1/2	0.08696	0.05648	1.8788	0.0170	1.8618	1.8223	0.0085	1.8138	1.7658
2	11 1/2	0.08696	0.05648	2.3528	0.0170	2.3358	2.2963	0.0085	2.2878	2.2398

All dimensions given in inches.

[1] These dimensions permit hose connections to American Standard Straight Pipe Thread.

[2] Dimensions for the minimum major diameter of the coupling correspond to the basic flat ($P/4 \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the coupling shall be that corresponding to a flat at the major diameter of the coupling equal to $P/8 \times p$, and may be determined by adding $1^3/_4 \times \frac{1}{8}$ (or 0.7939 p) to the maximum pitch diameter of the coupling.

[3] Dimensions given for the maximum minor diameter of the nipple are figured to the intersection of the worn tool are with a center line through crest and root. The minimum minor diameter of the nipple shall be that corresponding to a flat at the minor diameter of the nipple equal to $P/8 \times p$, and may be determined by subtracting $1^3/_4 \times \frac{1}{8}$ (or 0.7939 p) from the minimum pitch diameter of the nipple.

[4] The limiting dimensions for these sizes are identical with the dimensions given in the 1931, 1934, 1935, and 1933 Reports of the National Screw Thread Commission.

MACHINERY'S Data Sheet No. 342, New Series, March, 1937

Approved by American Standards Association, July, 1935

Some Suggestions in Tap Design

Based on Wide Experience in Nut Tapping, the Author Makes Some Definite Suggestions in Regard to Tap Design for Increasing Tap Life and Cutting Efficiency in High-Speed Tapping

By H. GOLDBERG, Vice-President
R. G. Haskins Co., Chicago, Ill.

IN order for a tap to have a long life in high-speed tapping operations, it is necessary that there be a definite relation between the width of the land and the pitch. Generally speaking, the width of the land should not be greater than is necessary to provide sufficient strength to prevent the tap from breaking when properly used. When the land is too wide, there is an increase in the frictional resistance; more heat is produced and more power is required for tapping. Wide lands cause the tap to load more rapidly.

It is therefore suggested that the width of the land should be governed by the pitch of the tap and not by its diameter. Experience has proved that from one and one-half to two times the pitch is ample for the width of the land, irrespective of the diameter of the tap. This means that the width of land on a 20-pitch tap should not exceed 0.100 inch. This width of land, of course, would be too wide for a 1/4-inch–20 tap, and in that case, the lower ratio of one and one-half times the pitch should be used, giving a width of land of 0.075 inch. Hence, a larger number of flutes must be cut in the larger diameter taps if the pitch is fine.

Most taps in the larger sizes have too wide a land for efficient high-speed tapping. It is argued that the wide lands are necessary, since a narrow land would not give the required support. This additional support, however, can be provided by increasing the number of flutes, so as to have a larger number of narrow lands rather than a small number of wide ones. In a 1-inch–20 tap, for example, six flutes with 0.100 inch width of land will give ample support and permit close tolerances to be maintained.

Many tapping jobs appear to be difficult because standard taps not suited for the special conditions encountered are used. For such jobs, special taps of proper design are recommended. This does not mean that the tap is responsible for all of the difficulties in tapping, but it is one of the important factors that must be considered. If the proper style of tap is not used, we must either reduce the tapping speed below that which would otherwise be possible or we must sacrifice the accuracy and quality of the thread.

When the proper style and design of tap for the material being tapped is used and the results are not satisfactory, the trouble must be sought elsewhere. There may be misalignment; there may be too great a weight on the spindle of the tapping machine; the machine may not be sensitive enough; the tap may run out; or an unsuitable cutting oil may be used. But a good starting point is to see that a tap of the correct design is employed.

Apart from the subject of the width of lands and depth of flutes, there is also the question of relief or clearance on taps. This question, however, is one for the specialist to consider and will not be dealt with here. The leading tap manufacturers can furnish advice on this point. The clearance or relief is of especial importance in connection with maintaining the required tolerances.

* * *

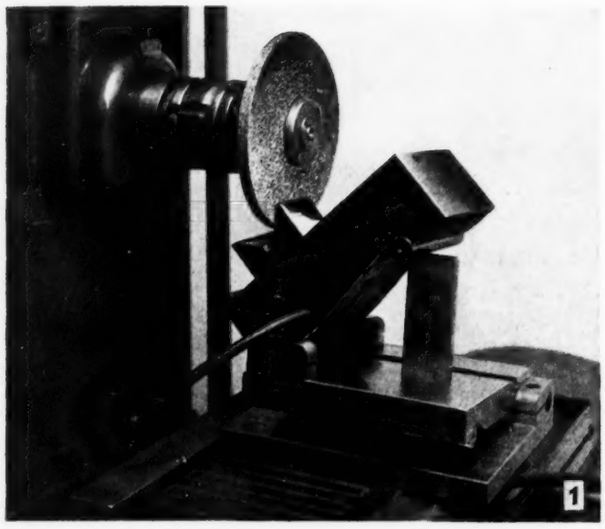
Machine Tool Standards Approved by the American Standards Association

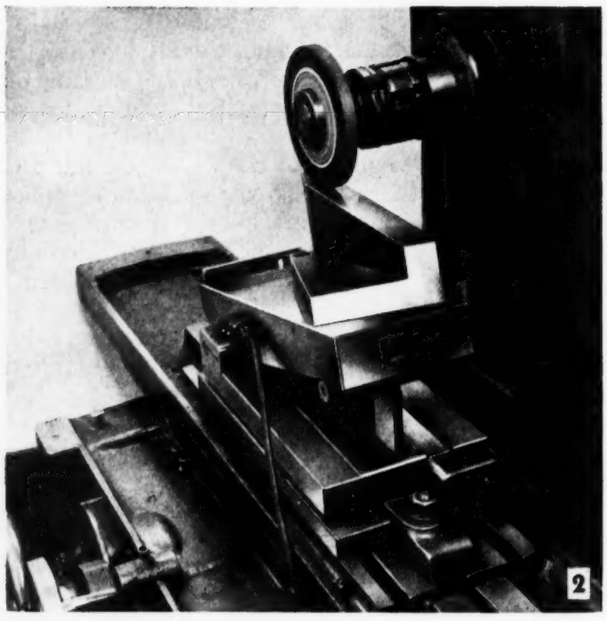
The American Standards Association has approved and published three new standards applicable in the machine tool and the machine building industries generally One of these applies to "Chucks and Chuck Jaws for Turret Lathes and Automatic Lathes;" another to "Lathe Spindle Noses for Turret Lathes and Automatic Lathes;" and a third to "Circular and Dovetail Forming Tool Blanks." All three standards are sponsored by the American Society of Mechanical Engineers, the National Machine Tool Builders' Association, and the Society of Automotive Engineers. Copies can be obtained from the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

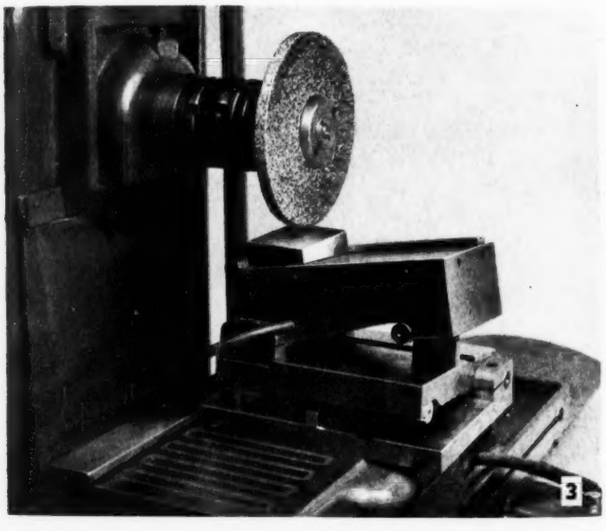
* * *

On January 18, the twenty-five millionth Ford car rolled off the assembly line at Dearborn, Mich. These 25,000,000 cars have been built for the market during the last thirty-three years. In 1915, Ford had built 1,000,000 cars; in 1924, 10,000,000 cars; and in 1931, 20,000,000.

Angular Surfaces in Tool-Room







TOOL-ROOM work frequently requires the grinding of flat surfaces to single or compound angles. In such cases, the holding of the piece in the correct position is likely to present difficulties. These are increased when the shape of the piece is such as to complicate clamping. Sometimes it is necessary to grind unimportant surfaces on a part accurately in order to provide a means of holding the surface to be ground in the proper plane. Similar conditions also exist in honing, lapping, and other operations, and in the inspection of finished work.

To facilitate the finishing and inspecting of such work, the Robbins Engineering Co., Detroit, Mich., recently brought out a magnetic chuck known as the "Magna-Sine," which can be accurately tilted to the required angle. This chuck is made in two styles, one for holding pieces at a single angle, and another that can be tilted to compound angles. Precision gage-blocks placed between ground and hardened flat surfaces and cylindrical bars insure accurate settings of the chuck table. Parts of ferrous materials are held magnetically, thus eliminating the danger of distorting frail pieces by the use of clamps. With this new chuck, it is unnecessary to grind surfaces accurately merely for locating purposes.

Chuck Designed for Compound Angles

From the illustrations, it will be seen that the chuck designed for compound angles consists essentially of a base which is placed on the table of the machine. Hinged to one end of the base is a plate that can be tilted to any angle by merely employing precision gage-blocks between the top of the base and the cylindrical bar which extends the full length of the hinged plate on the under side. The chuck table is hinged in a similar manner to the plate, except that the hinge is at right angles to the plate hinge. Gage-blocks are used between the top surface of the hinged plate and the cylindrical bar that extends across the under side of the chuck table to insure accurate settings.

With this construction, it is possible to set the chuck table to any desired compound angle. In Fig. 1, for example, the operation consists of grinding V-surfaces which are inclined not only toward each other crosswise, but also endwise. The application of the gage-blocks to obtain the required compound angle is clearly shown. The angle of the vee crosswise is 45 degrees, and endwise 6 degrees.

Ground Quickly Operations

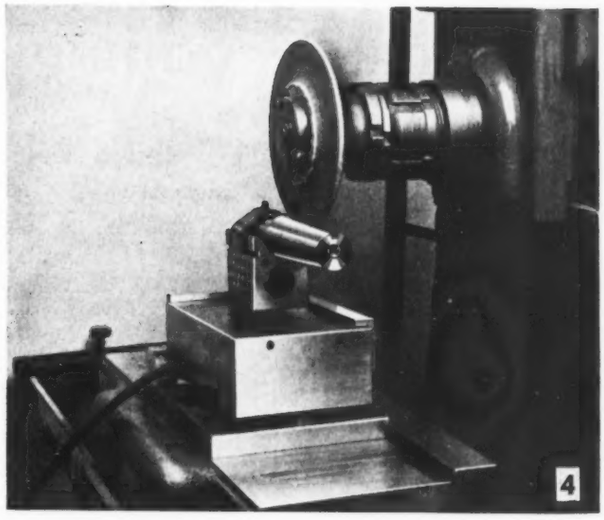
The Magna-Sine is made in two sizes equipped with tables 10 3/4 and 7 inches long, the widths being 6 and 5 inches. On the larger model, the distance from the center of each swiveling point to the corresponding cylindrical bar is 10 inches, and on the smaller model 5 inches. Tables of constants are supplied which instantly give the built-up height of gage-block combinations necessary to obtain any required angle in degrees and minutes from 0 to 60 degrees. Slots are ground to a depth of 0.100 inch across the top of the base and the tilting plate to accommodate a gage-block when the height to which the hinged plate or the table is to be tilted is less than the smallest gage-block height. These slots enable accurate angular settings as small as 1 minute. After a setting has been made, the adjustable members of the device are securely clamped.

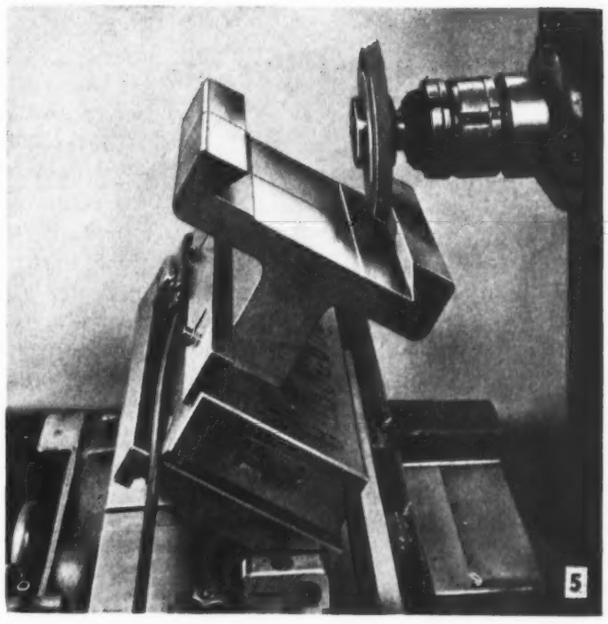
For the operation shown in Fig. 2, only the chuck table had to be tilted, the desired angle being obtained by using a combination of three gage-blocks. This is an example where the Magna-Sine is clamped to the ordinary table of a surface grinder instead of being placed on a magnetic chuck, as in most of the other examples shown. Fig. 3 illustrates an operation in which a block had to be ground to a combination of two angles, 5 degrees 10 minutes 32 seconds, and 10 degrees 31 minutes. The correct setting was readily made as shown.

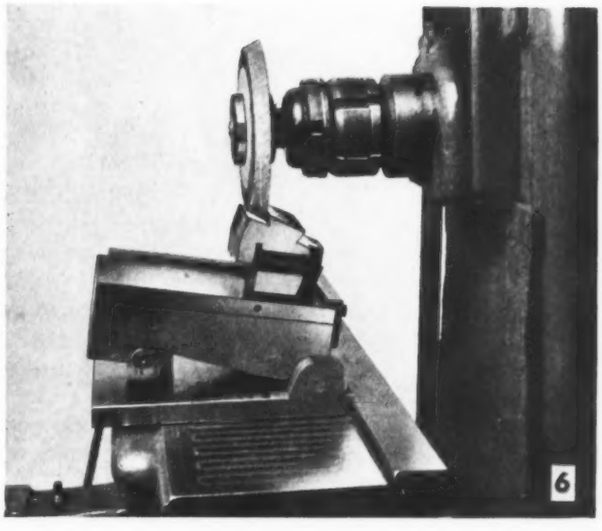
Sometimes a keyway of uniform depth must be ground in a tapered surface. Such an operation on a tapered plug gage is shown in Fig. 4, the gage being clamped in a V-block which is seated on the magnetic top of a Magna-Sine of the type that can be tilted to a single angle only.

Grinding Dovetail Surfaces

Another class of work which is simplified by the use of this equipment is the grinding of dovetails, both internal and external. An internal dovetail is shown being ground in Fig. 5 in a piece of an unusual shape that would be difficult to clamp. After one side of the dovetail was finished, it was an easy matter to grind the opposite side by merely turning the work end for end. The chuck was tilted 30 degrees for this operation. An external dovetail is shown being ground in the set-up illustrated in Fig. 6. Because of the adjustment possibilities of the Magna-Sine, a grinding wheel dressed to one angle can be used for grinding dovetails of various angles.







Automatic Forming Die for Half-Bushings

A Roll Feed and a Compound Feeding Mechanism of Unique Design are Applied to a Five-Station Forming Die for the Production of Half-Bushings from Strip Stock

By WARREN P. WILLETT

ALTHOUGH the principles of design incorporated in the die and feeding mechanism shown in the accompanying illustrations can be applied to the manufacture of any one of a number of small parts, this description applies especially to their application in the manufacture of tapered half-bushings of the shape and general proportions shown at *B*, Fig. 1. In certain makes of automobile engines, two of these half-bushings are used together in a groove on each valve stem, for the purpose of locking the spring retainers in place.

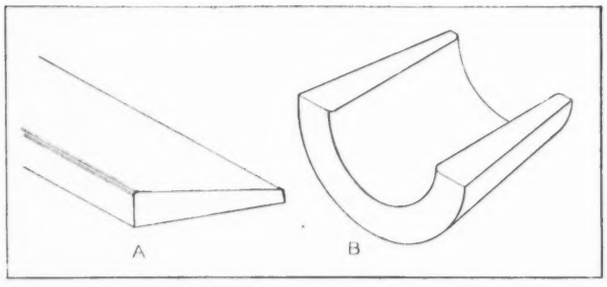


Fig. 1. (A) Wedge-shaped Cold-rolled Steel Stock; (B) Tapered Half-bushing Made from Stock A by Die Shown in Fig. 2

The taper is on the outside of the bushing only, the inside being made straight to fit a straight groove in the valve stem. The sizes vary with the size of engine on which they are used, the most common size probably being about 1/2 inch at the greatest diameter and 1/2 inch long. The material used is a special cold-rolled steel shape with a tapered cross-section, as shown at *A*, Fig. 1.

The sequence of operations is indicated in Fig. 2, which shows a longitudinal cross-section through the die. The strip stock is fed into the die by a roll feed mounted on the left-hand side of the press bolster plate; it is indicated in the illustration with its forward end against the stop gage, ready to be cut off. The blanks shown in the dies are ready for their respective forming operations.

At the first station, the stock is cut off, with the ends slightly beveled to form the correct conical development of the blank. At the second station,

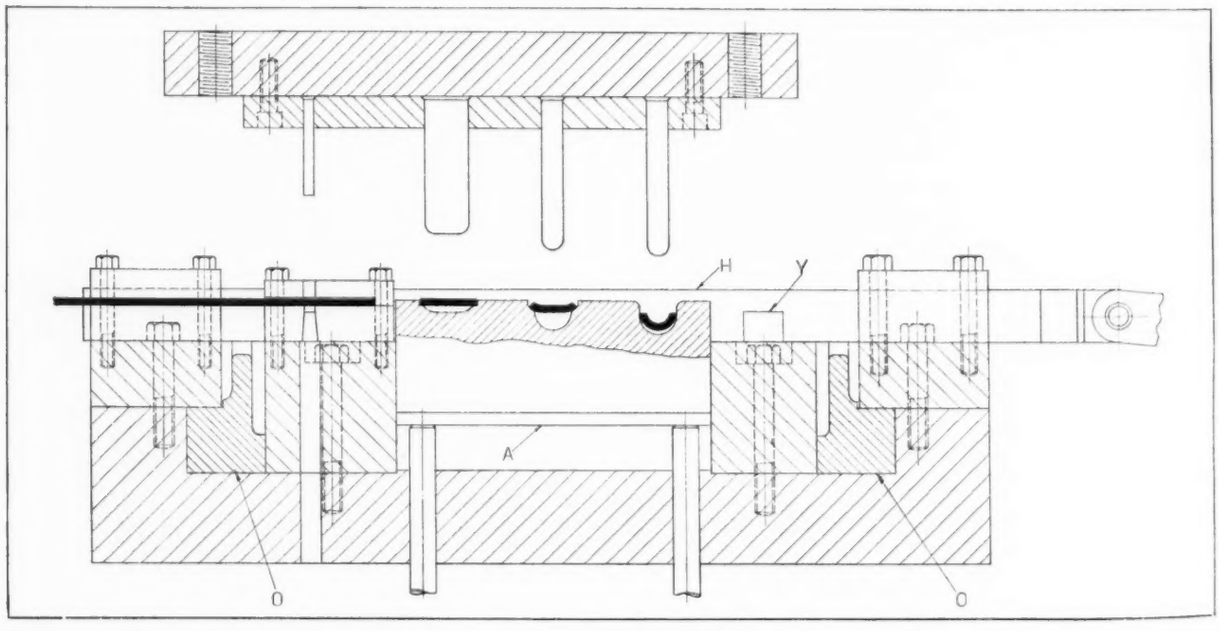


Fig. 2. Longitudinal Cross-section through Die, Showing Sequence of Operations in Producing Half-bushing B, Fig. 1

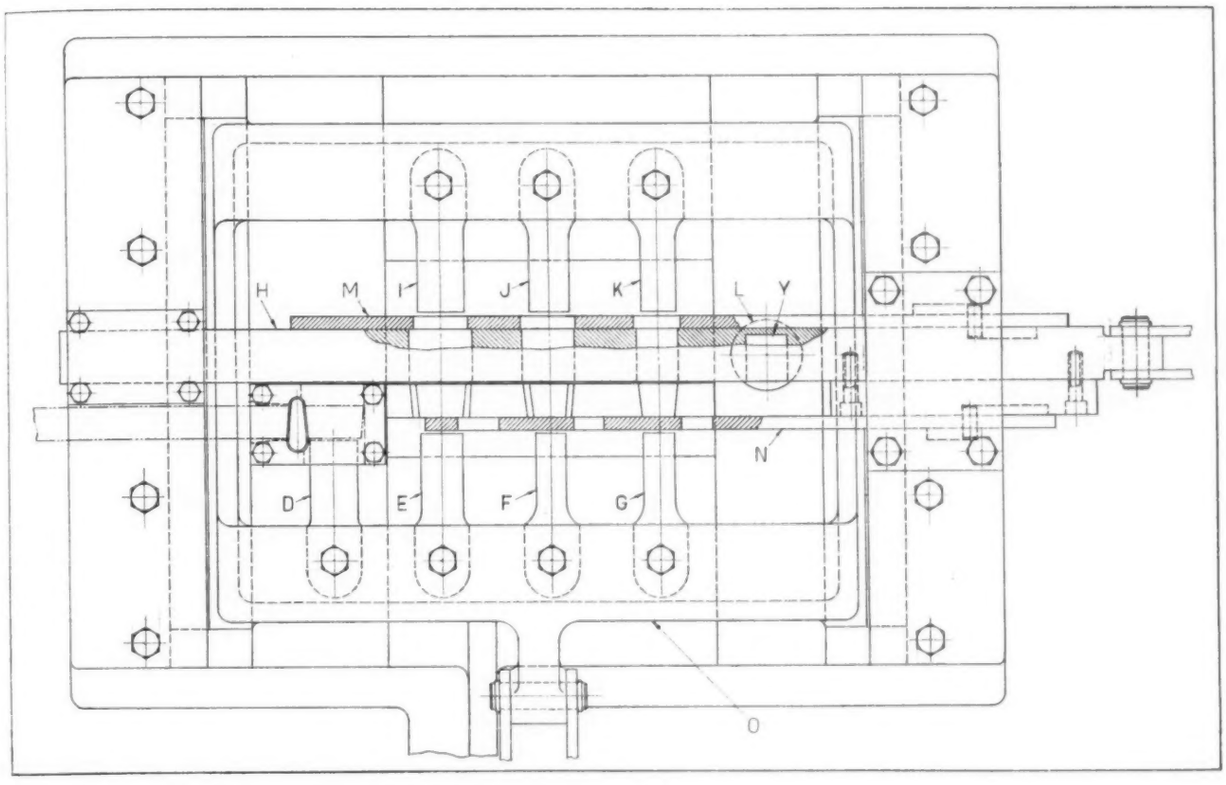


Fig. 3. Plan View of Die for Producing Half-bushing, Showing Arrangement for Advancing Work through Successive Stages

the forming is started by bending up the ends of the blank. At the third station, the forming is completed, and at the fourth, the sizing is done. At the fifth, the finished part is ejected.

The transfer between stations is facilitated by the construction of the die. Fig. 4 shows a transverse cross-section of the die, consisting of a pad *A*, floating perpendicularly between the two side plates *B* and *C*. In this pad are machined the dies for the different forming operations. Each of these dies has a matrix above it, as shown in Fig. 2, which is shaped to receive the blank in its previously formed condition. The floating pad is supported by pins passing through the die-shoe and die-bolster and resting on a bumper rubber beneath the bed of the press.

By this means, the pad is given sufficient movement upward to lift the bottom of the dies clear of the side plates, so that the blanks, in their different stages of completion, can be pushed from the dies into a transfer slide *H*. In operation, the pad recedes under the pressure of the punches until it reaches the limit of its downward motion. With the pad in this position, the blanks, resting in their matrices, are constrained by the side plates against sidewise movement during the forming operations. As the punches move upward and the pad reaches a position where the blanks are clear of the side plates, the pusher fingers *D*, *E*, *F*, and *G*, Fig. 3, advance, pushing them into the transfer slide *H*. The pusher fingers then recede while the transfer slide advances one station to the right. The loading fingers *I*, *J*, and *K* now advance, pushing the blanks from the transfer slide into the dies for the next forming operations, after which the loading fingers recede and the transfer slide returns to its former position at the left.

With each movement to the right, the transfer slide moves one completely formed and sized piece of work to the ejection station *L*, where it drops through a hole in the die base and bolster. The recesses in the transfer slide, with the exception of the one at *Y*, Figs. 2 and 3, are shaped to fit the blanks in their different stages of formation. In

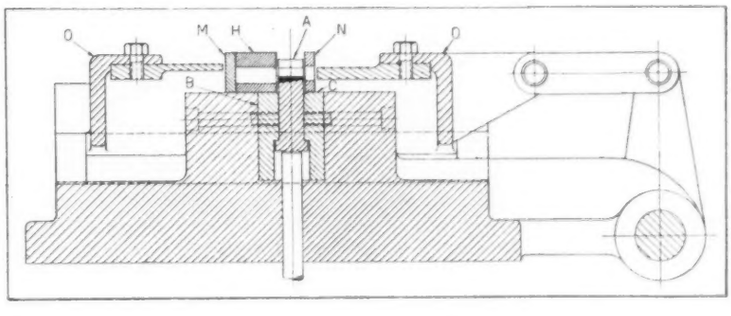


Fig. 4. Transverse Cross-section through the Center of the Die Shown in Figs. 2 and 3

this way, the blanks are transferred to successive stations in such a position that they can readily be pushed into the matrices of the dies. Recess *Y*, being open at the bottom, allows the completed part to fall out at the ejection station.

An interesting feature of this die is the method used to arrest the motion of the blanks so that their momentum will not carry them too far as they are pushed in and out of the dies. This is accomplished by means of the sliding line-strips *M* and *N*, which act as back stops along the outer line of the transfer slide and die, respectively. Suitable openings are provided in the line-strips for the admission of the various pusher fingers. The movements of the line-strips are timed to suit the movement of the pusher fingers.

The line-strips have a floating connection with the transfer slide, from which they derive their movement through a lost motion arrangement which permits sufficient movement in the line-strips to open and close the passages across the dies and to do this at the proper time. The driving connection between these members is made by means of pins which are pressed into the line-strips and project on each side of them.

The projection on one side slides in a groove in the transfer slide, and that on the opposite side slides in a groove in the fixed guide near the right-hand end of the transfer slide. This is shown in Fig. 3. These pins also serve to gage the motion of the transfer slide for, although the drive is from double-acting cams, and positive in both directions, there is a flexible connection in the linkage, as described later.

The pusher and loading fingers are mounted in the cross-slide casting *O*, Figs. 2, 3, and 4, which is a light skeleton structure with two cross-members which span the die assembly in such a way as to provide support for the fingers. The ways for the cross-slide run at right angles to and under the transfer slide.

In Fig. 5 is shown an outline assembly of the complete mechanism mounted on the press. The feed movements are actuated by the cams *P*, *Q*, and *R* on the crankshaft extension at the left side of the brake. Both the roll feed and the transfer slide are actuated by the radial cams *P* and *Q*, two cams being used for this movement in order to obtain positive motion in both directions. The yoke for the connecting linkage is between the two cams. Motion for the roll feed is transmitted through the lever *S*, and for the transfer slide through the levers *S*, *T*, *U*, *V*, shaft *W*, and connecting links. Motion for the cross-slide comes from the race cam *R* through the yoke at its outer face and connecting linkage.

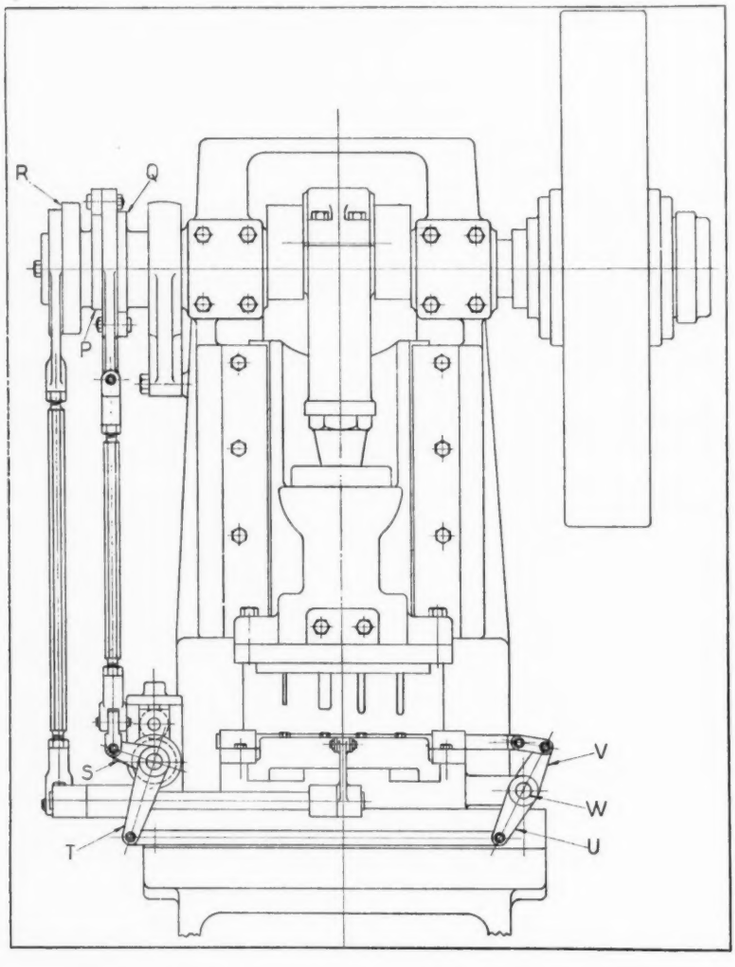


Fig. 5. Outline Assembly of Press, Die, and Feed Arrangements Used in Producing Half-bushings B, Fig. 1

The immediate connection to the transfer slide is not positive, but it is cushioned by spring action in both directions in order that the travel of the slide may be accurately gaged by the stop-pins in the line-strips. For that reason, the cams for this member are designed to impart slightly more motion than is required to move the slide between stations. By this means, the accuracy of the registering of the transfer slide stations with the die stations does not depend upon the doubtful accuracy of cams and connecting linkage, but on the predetermined travel of the stop-pins. The details of the spring cushioning device are shown in Fig. 6.

The lever *V* is linked directly to the transfer slide, but it is not keyed to the shaft *W*, upon which it is free to turn. The yoke *X*, within which the lever rides, is keyed to the rock-shaft by a taper pin. The driving connection between *V* and *X* is the detent ball *Z*, which is held tightly in the V-notch by a stiff compression coil spring.

Another function of the detent is to provide a safety feature in case there should develop any obstruction to the movement of the slide. Other safety

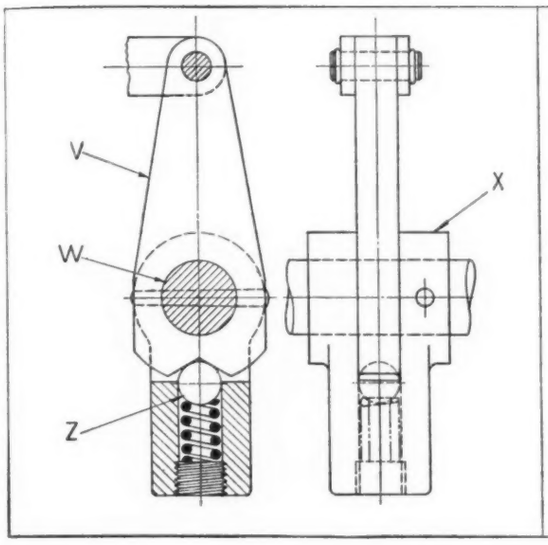


Fig. 6. Details of Spring Cushioning Device on Transfer-slide Driving Arm

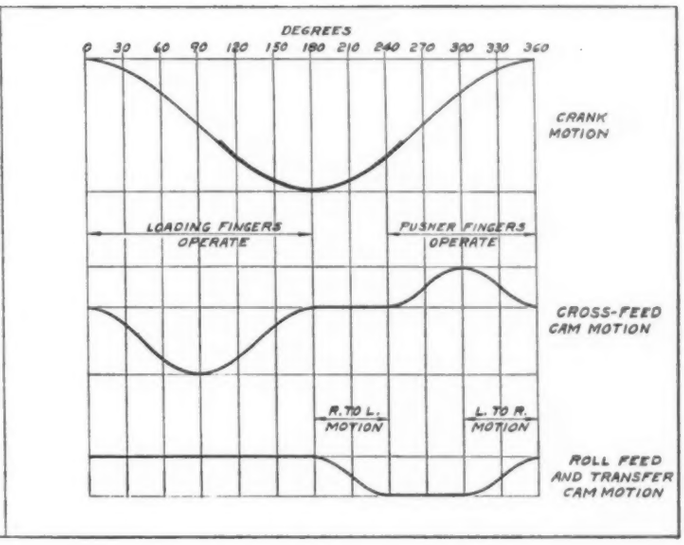

DEGREES
0 30 60 90 120 150 180 210 240 270 300 330 360
CRANK MOTION
LOADING FINGERS OPERATE
PUSHER FINGERS OPERATE
CROSS-FEED CAM MOTION
R. TO L. MOTION
L. TO R. MOTION
ROLL FEED AND TRANSFER CAM MOTION

Fig. 7. Timing Diagram of Press Ram Movements and Work Transfer Mechanism Shown in Figs. 2 to 5

devices are, of course, necessary to provide complete protection for all moving parts. These are of the usual type, involving the use of an extra throw-out latch for the clutch, so that the press will stop in case anything happens to disrupt the timing of any of the moving parts.

The timing of the different movements is rather close, as shown by the timing diagram, Fig. 7. In some cases, the movements overlap each other, but the diagram shows that there is not any interference. The stroke of the press crankshaft is indicated by the curve at the top of the chart. In order to allow ample time for all of the feed movements to act smoothly, the crankshaft is designed with a slightly longer stroke than would ordinarily be required for the work alone. The portion of the stroke actually required for the work is indicated by the heavy portion of the curve. During this period, the punches and the blanks are in contact with each other, and the blanks must not be moved by either the loading or the pusher fingers.

With the crank in its starting position at top center, the transfer slide is at its extreme right-hand position. As the crank moves downward, the loading fingers advance, pushing the blanks into the dies just before the punches come in contact with them. The loading fingers then recede to their neutral position and stop. At this instant, the transfer slide begins to move from right to left, where it stops.

The pusher fingers start to advance just before the end of the working period of the crank is reached, as they have to travel through line-strip *N* before they will be in contact with the blanks, and by careful timing, they are caused to reach the blanks just as the punches leave them. As the crank continues upward, the pusher fingers complete their forward motion, pushing the blanks into the transfer slide. This being done, the pusher fingers begin to recede, and simultaneously the transfer slide starts its left to right motion, carrying the blanks to the next die station. The feed rolls, being actuated by the same cam as the transfer slide, move the end of the strip stock up to the gage, ready for the cut-off die to shear off another piece. All feed movements are completed when the crank reaches top center. This makes an ideal arrangement for an initial starting of the press, as none of the feed movements have to be started at a point of high acceleration.

* * *

Replacing Machines Before Obsolete Often Proves Profitable

In an article in the *Executives Service Bulletin*, published by the Metropolitan Life Insurance Co., W. E. Whipp, president of the Monarch Machine Tool Co., Sidney, Ohio, describes the replacement policy of the Monarch company. In this article, he mentions that the company sometimes replaces machines that are still "in almost the pink of mechanical condition, because new machines have been developed which will produce a product of higher quality at a lower production cost. It thus happens that many replaced machines are not more than four to six years old. Production figures prove that these investments in new machines will be returned in from two to five years."

"It would be difficult," says Mr. Whipp, "to employ our treasury funds in any way that is better calculated to earn big returns for our stockholders."

Of all the machine tool equipment in use in the Monarch plant, 83.5 per cent is less than ten years old. In other words, only one-sixth of the total equipment is more than ten years old. The average age of all the equipment used in that plant is seven years.

Engineering News Flashes

The World Over

How Much a Pound for Automobiles?

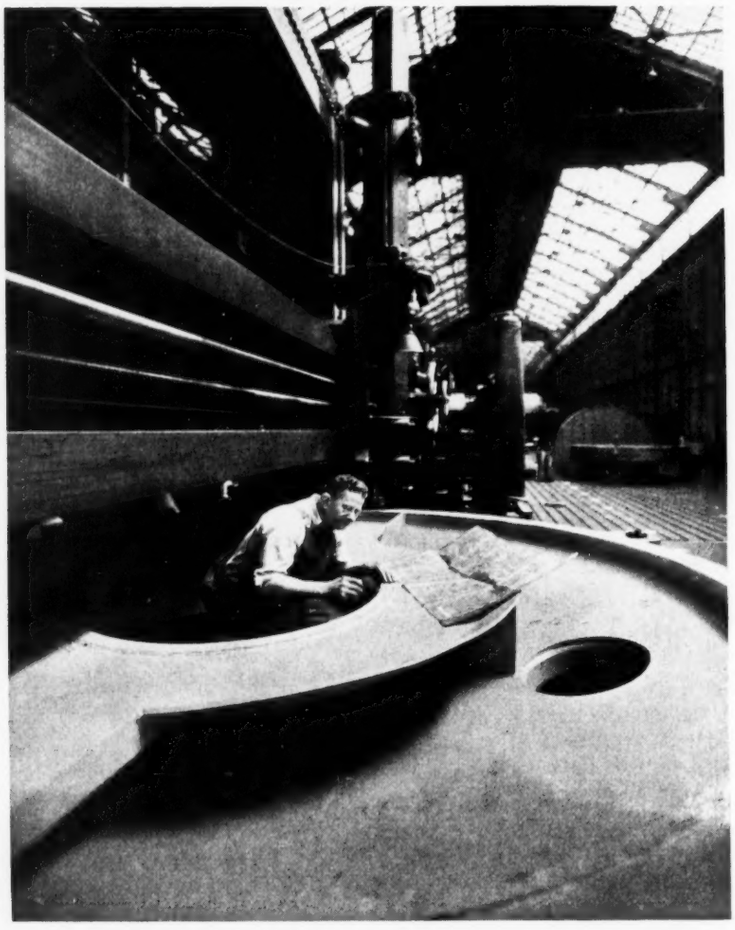
While, in general, it may lead to erroneous conclusions if one bases the price of machinery on a per-pound basis, it is, nevertheless, of interest to note the low price per pound at which automobiles can now be bought, especially when it is remembered that their quality, and the quality of the materials from which they are made, never was better.

In one of the radio addresses by W. J. Cameron of the Ford Motor Co., it was mentioned that one of the 1937 Fords costs just about 20 cents a pound. In 1925, a "pound of car" cost 41 cents. Mr. Cameron also makes this rather interesting comparison with other commodities: Beefsteak costs 30 cents a pound [it costs a good deal more in some parts of the country]; a refrigerator, about 40 cents a pound; a piano, around 87 cents a pound; a good radio, about $1.65 a pound; and a suit of clothes, about $7.50 a pound—all excellent values; but an automobile at 20 cents a pound is certainly an achievement when compared with these figures.

Paint that Changes Color when Exposed to Heat

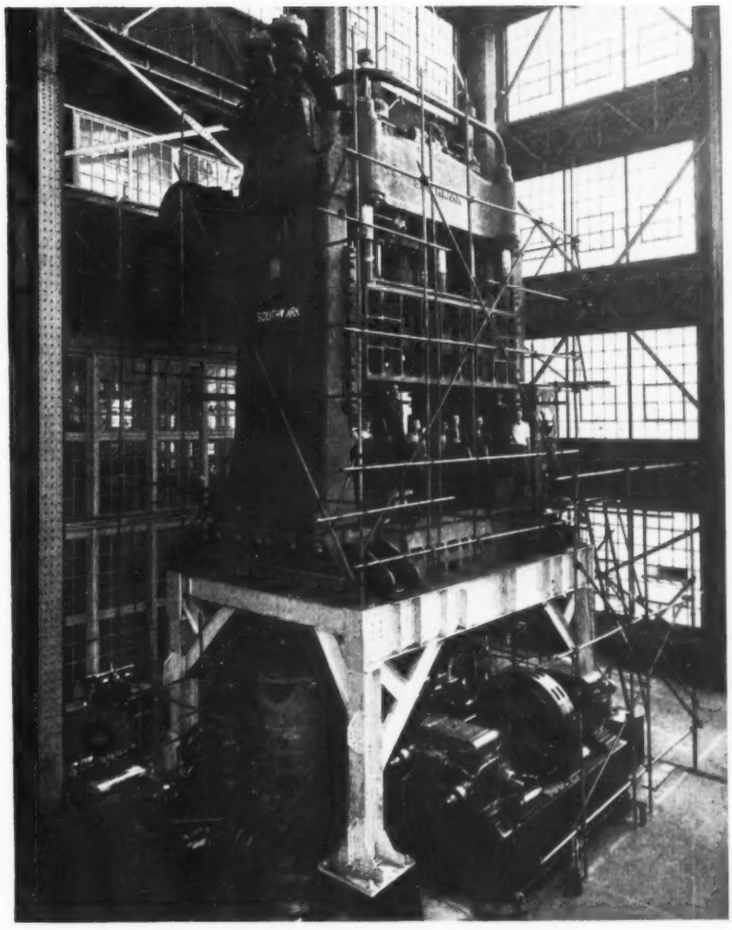
Paints known by the trade name "Efkalin" have been introduced into the United States by the Efkalin Co., 804 E. 141st St., New York City. The interesting point about these paints is that they change color when exposed to heat, so that they can be used as heat warnings. They can be employed, for example, on visible machine parts subjected to friction and undue heating, and also on machine elements carrying electric current that may cause heating. Obviously, they are particularly applicable in cases where a machine or part may be damaged or destroyed by overheating.

Since these paints change color when exposed to heat, excessive heat may be observed from a distance. Some of the Efkalin colors regain their original color when cooled; others remain permanently changed. There are seven paints in the first class, and five in the latter series. The permanent-change paints will change color at temperatures ranging from 300 to 735 degrees F.; the others are applicable to temperatures as low as about 105 up to 465 degrees F. The paints that return to the original color when cool are good for from twenty-five to fifty changes before recoating, while obviously, the permanent-change paints require recoating after each change. These paints will protect



Preparing the end dome of a 35,000-kilowatt hydrogen-cooled alternating-current turbo-generator for boring, facing, and turning. The generator is built in the plant of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for the Union Gas & Electric Co.

A 1000-ton triple-acting hydraulic press for the Fisher Body Corporation at Cleveland, recently built by the Eddystone plant of the Baldwin-Southwark Corporation, Philadelphia, Pa. There is a clear distance of 16 feet between the side housings. The maximum vertical "daylight" of the inner slide is nearly 12 feet. The press stands more than 28 feet above the floor level, while there is a depth of 14 feet of the huge machine below this level. The press weighs 650,000 pounds.



surfaces for twelve months. Their advantages when used on bearings, motor housings, transformers, tanks for hot water and liquids, transmissions, etc., are obvious.

Welded High-Pressure Locomotive Boilers

What is believed to be the first high-pressure boiler ever made with welded barrel and dome, under the rules of the A.S.M.E. Code for fusion welded vessels, was recently completed by Farrar & Trefts, Inc., Buffalo, N. Y. The new boiler is of the locomotive type, and is for use in the oil fields. The barrel is 16 1/2 feet long and 62 1/2 inches outside diameter. It is made from steel plate 1.15 inches thick, electrically welded by the Shielded Arc process with Lincoln equipment. The two longitudinal welds of the barrel were hammer-tested at a pressure of 575 pounds, and leak-tested at 700 pounds hydrostatic pressure.

World's Largest Steel Wire Rope

What is believed to be the world's largest steel wire rope was recently produced in Warrington, Lancashire, England. This rope is 4 5/8 inches in circumference and is approximately 7 1/2 miles long, in one continuous length, without joints or splices. It weighs approximately 57 tons. The rope consists of 114 wires grouped in six strands, each of nineteen wires. The six strands, in turn, are assembled around a manilla center. When in service, the working speed of the rope will be 13 1/2 miles an hour.

Improved Rustproofing Process

A new process known as the "Dip-Spra" bonderizing method has been developed by the Parker Rust-Proof Co., Detroit, Mich. This new method adapts a prior process, known as "Spra-Bonderizing," developed a couple of years ago, to the needs of producers whose requirements do not justify the installation of conveyor equipment. The object of the process is to produce a corrosion-inhibiting coating, not only on iron and steel, but also on galvanized, zinc alloy, and cadmium surfaces. In addition to being corrosion-resistant, the coating is highly adherent, being practically integral with the metal itself, and, having slight porosity, it forms an effective base for any type of paint finish. The equipment for the new process is comparatively simple and easy to install, as it consists only of a steam-heated processing tank in which a spray pipe is placed above the solution level.

Economical Performance of Tractors

Which is the cheaper in the long run—a high-priced or a moderate-priced tractor? An experiment to settle this question is being undertaken by the British American Oil Co. in Canada. According to *Industrial Britain*, a comparison will be made of the total expense involved in the operation of a high-priced heavy-duty tractor which can be used advantageously for a number of years, and a moderate-priced tractor which would have to be replaced every year or two. It is expected to use the tractors in similar service with a view to covering approximately 75,000 miles in a year.

EDITORIAL COMMENT

Many measures enacted into law by the federal and state governments during the last few years have been vigorously opposed by industry, and rightly so, because much legislation, hastily conceived, has been sponsored by minority interests who have not the welfare of the country as a whole at heart. But it is not enough for industry to criticize and oppose; real results can be obtained only through constructive effort. Business and industry must formulate definite measures as a basis for future legislation. Only by such action can industry expect to have a voice in legislation.

Industry Must Aid in Guiding Public Policies

Some of the legislation that has been passed to govern the relations of employer and employe is in the best interest neither of industry nor of labor. Some of the laws governing business have retarded rather than stimulated recovery—curtailed rather than increased employment; and so have many of the tax laws approved by the Administration.

Business and industry, however, have failed to propose definite measures, which, if enacted into law, would have promoted the general welfare. Granted that it might not have been possible to have such measures enacted into law by Congress; still much would have been gained by a discussion of specific measures, in specific terms.

Fair-minded members of the old established labor unions agree with employers that some of the laws recently passed covering labor relations have not been so much in the interest of the workers themselves as in the interest of irresponsible, self-appointed leaders of labor, who do not have the workers' interest as much at heart as their own opportunities for power, prestige, and profit. Members of the older, well managed labor unions can have no objection to having their union placed on the same plane of responsibility as are business enterprises. They can have no objection to being asked to incorporate on the same basis as a corporation, and to have labor union leaders held responsible for the actions of their unions in the same manner as are the officers of a business for actions of their company.

Business and Labor Should Assume Same Responsibility

Such legislation should be definitely drafted and proposed by industry. Recent events in the automobile field show how necessary is such legislation. In the automobile strike, law and order were utterly disregarded; still, the leaders who incited these lawless conditions could not be held legally responsible. That these lawless actions were not denounced by federal and state administrations, but instead tacitly approved, is the most serious factor in the situation.

Every fair-minded man recognizes the right of all citizens to organize associations or unions. Manufacturers and workers alike have an undeniable right to do so, and to further their best interests by all peaceful means. But when coercion and violence step in, the first duty of Government is to maintain law and order—to punish men who incite others to break the law. If present laws are not adequate, then industry has a duty to perform in formulating and advocating such legislation as will promote fair and peaceful settlements of differences that arise between workers and their employers.

Lawful Settlements of Labor Questions Should be Early Aim

Another important field for constructive effort on the part of industry is that of taxation. The amount paid in taxes, within reasonable limits, is actually of less importance than the fiscal policies governing the levy of taxes. Wise fiscal policies will encourage business; unwise taxation will hamper and crush industrial endeavor.

Even an efficient and economically conducted government cannot exist without income; and in opposing unfair and harmful taxes, industry should propose definite constructive measures to take the place of such taxes. A great service would be rendered if business and industry formulated rational methods of taxation that could be proposed as counter-plans to the enacted measures.

Industry, practically without protest, has borne, year by year, the burden of increased taxation; because there were no protests, governments—federal and state—may have believed themselves justified in imposing these burdensome taxes. A definite protest needs now to be registered.

A great opportunity presents itself to industrial leaders and trade organizations to assume constructive leadership in the formulation of Government policies. The welfare not only of those engaged in industry, whether as managers or workers, but of the nation as a whole, is involved.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Straight-Line Motion

By FRANK E. RUNGE

The device shown diagrammatically in the accompanying illustration was developed by the writer to obtain a movement of the point *B* in a straight line from *D* to *E* when point *A* of the fork *H* is moved from *F* to *G*. This, however, is only one of several possible motions that can be obtained by applying the same general principles to the construction of a motion-transmitting device of similar design.

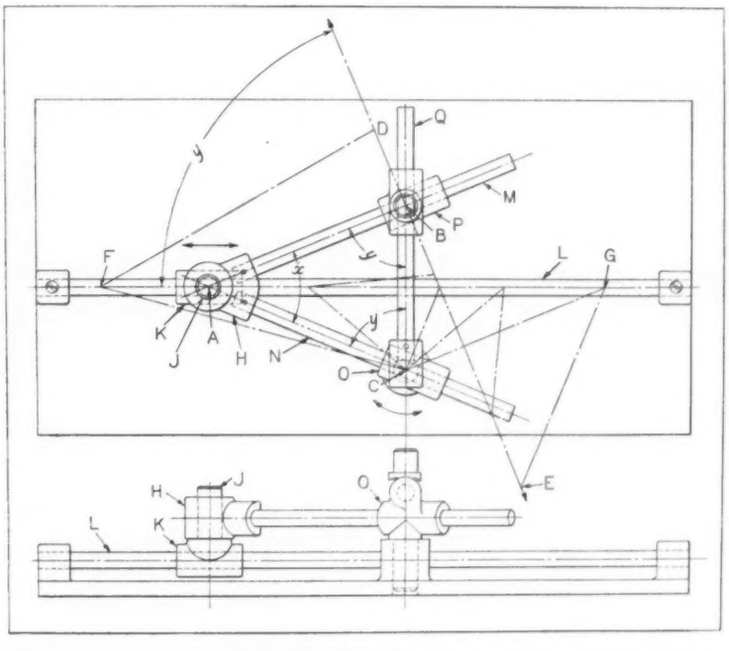
Referring to the construction of the device, fork *H* is free to oscillate about pivot *J* on slide *K*. This slide is free to move along the fixed rod *L*. Rods *M* and *N*, fixed in fork *H* at angle *x*, are free to slide through members *P* and *O*, respectively. Member *O* is pivoted at a fixed point in relation to rod *L*.

Rod *Q* is fixed in member *O* at the angle *y* of the isosceles triangle *ABC*. The rod *Q* is free to slide through member *P* at the fixed angle *y* in relation to rod *M*. As *A* is moved along rod *L* triangle *ABC* changes its altitude, but always remains isosceles. The triangle oscillates about *A* in relation to slide *K*. As it oscillates about *A* the point *B* travels in a straight line *DE* at the angle *y* in relation to rod *L*.

The movement of *A* is uniform with that of *B* in the proportion given in the equation:

$$\frac{\text{Movement of } A}{\text{Movement of } B} = \frac{\text{Leg } AB}{\text{Base } BC}$$

When point *A* of slide *K* has reached point *G* on rod *L*, the point *B* will be at point *E*. Various intermediate positions of rods *M* and *N* are indicated by the light dot-dash lines.



Mechanism Designed to Move Point B in Straight Line from D to E when A is Moved from F to G

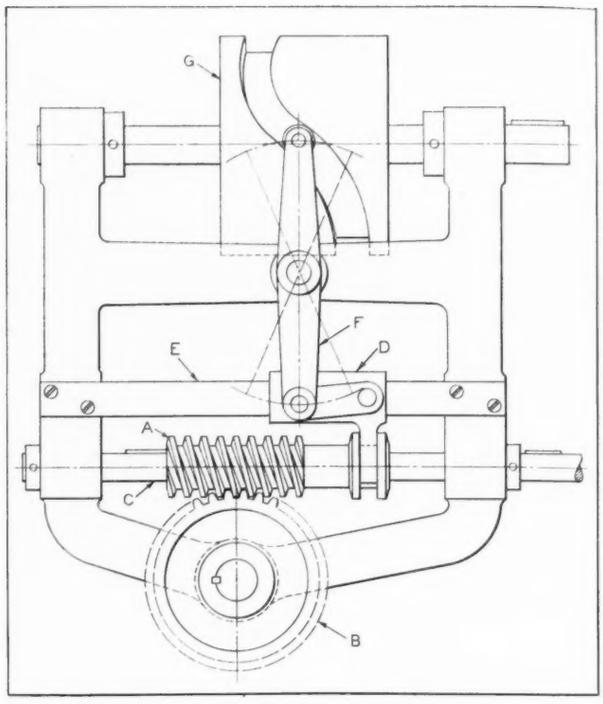
Mechanism for Varying Speed and Direction of Shaft Rotation

By F. H. FAIRWEATHER

A mechanism for controlling the speed or direction of rotation of the wheel or shaft of a machine is shown in the illustration (see next page). The worm *A* which drives the worm-wheel *B* is a sliding fit on the splined shaft *C* which rotates at a constant speed. The axial movement of worm *A* is controlled by the combined action of the yoke *D*, which is free to slide on the rectangular bar *E*, and the swinging cam-lever *F*, together with its actuating cam *G*.

It will be seen that the cam groove can be designed to give the worm-wheel any desired movement, as to speed and direction of rotation, within certain limits. For instance, if the worm is moved axially in the direction its rotation would normally drive the worm-wheel, the speed of the worm-wheel will be increased. If the cam groove causes the worm to move axially in the opposite direction at a speed equivalent to the rotational speed of the worm-wheel at the pitch line, the worm-wheel will stop. By increasing the axial speed of the worm in the

reverse direction, the worm-wheel will rotate in the reverse direction. Thus, with the combined movements of the worm and wheel, and the rack and gear action of this mechanism, it is possible to obtain variations in speed and reversal of the direction of rotation.



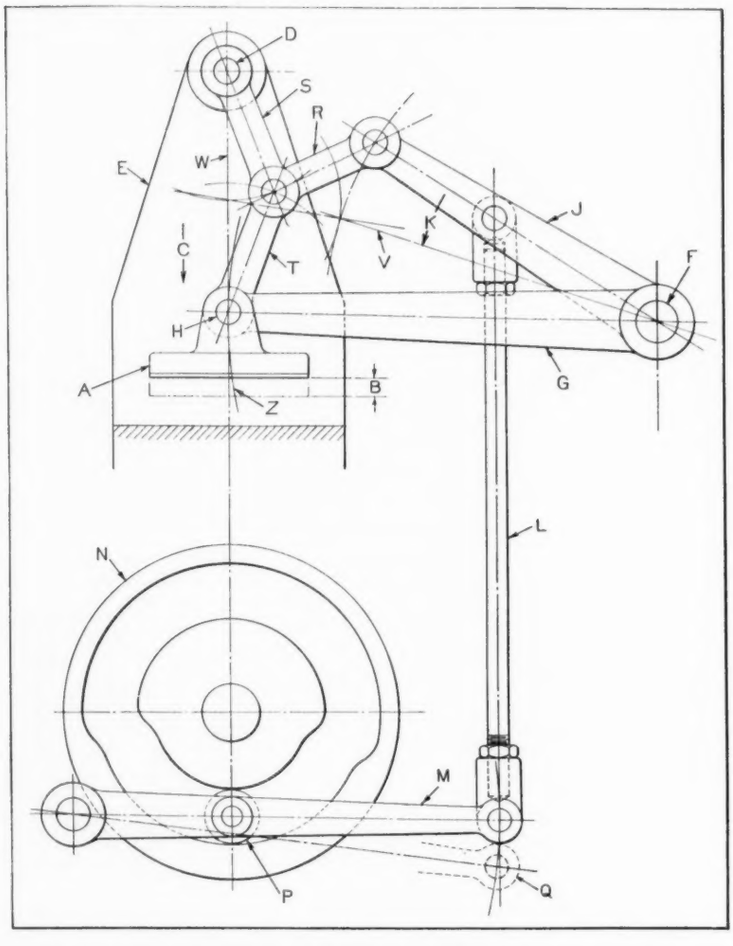
Mechanism for Varying Speed and Direction of Shaft Rotation

Combination Toggle and Lever Mechanism for Operating Pressure Pad

The pressure pad *A* of the mechanism shown in the accompanying illustration is moved up and down through a distance *B* along arc *Z* by the rotating cam *N*. The movement of the stud *H* of the pad along the path indicated by arc *Z* gives the pad a horizontal movement. This horizontal movement is so slight, however, that it can be disregarded in the case of the mechanism shown, although it might, of course, be objectionable for certain purposes.

The action of the toggle mechanism operated by the cam *N*, roller *P*, lever *M*, and rod *L* enables the pad *A* to exert considerable downward pressure. The illustration shows the lever *M* and the pad *A* at the top of their strokes. When the rotating cam moves the lever *M* to its lowest position, shown by the dotted lines at *Q*, rod *L* will have pivoted lever *J* about rod *F* in the direction indicated by arrow *K* until the center line coincides with the line *V*.

This action results in bringing link *R* downward until it is almost in line with lever *J*, and causes lever *S* to pivot about the pin *D* fixed in the housing *E* until it is in a vertical position on line *W*. The link *T* of the toggle arrangement is thus forced into a vertical position, causing pad *A* to move downward in the direction indicated by arrow *C* along the path of arc *Z* for a distance *B*. The function of lever *G* is to restrict the downward movement of the stud *H* to the path indicated by arc *Z*. H. M.



Mechanism for Imparting Stroke of Length B to Pressure Pad A

* * *

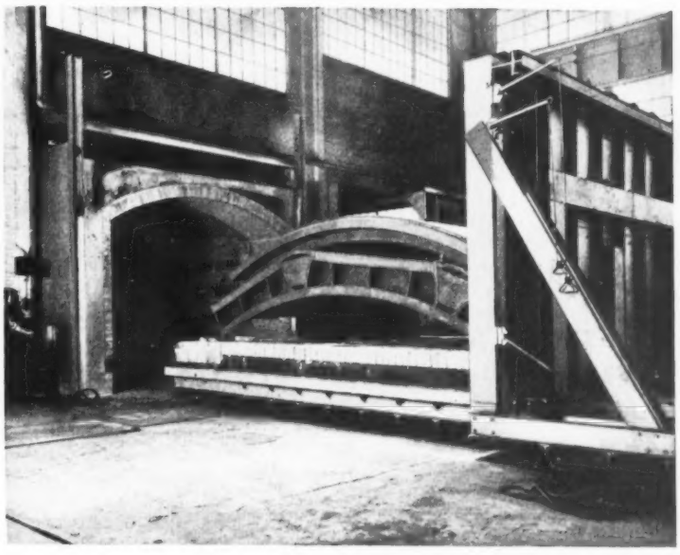
Czechoslovakia Reduces Tariffs

In order to enable Czechoslovakia to participate more fully than heretofore in the international exchange of goods, the government of that country has lifted a considerable part of the import restrictions, and more than two-thirds of the articles imported into Czechoslovakia are now entering free of duty. Countries importing Czechoslovakian goods may, therefore, expect a considerable increase in reciprocal trade with that country.

The Annealing of Welded Work

Methods of Determining when Welds Should be Annealed to Relieve Residual Stresses and Produce Desirable Metallurgical Changes, and Outline of Annealing Processes Recommended

By CHARLES H. JENNINGS
Chemical and Metallurgical Division
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.



MACHINE beds, frames, and structures fabricated by the fusion welding process contain a certain amount of residual or locked-up stress as a result of the non-uniform heating and cooling of the parts welded and the progressive solidification of the deposited weld metal. The magnitude of these residual stresses depends upon many factors, such as the type and design of the structure, the rigidity of the joints, the welding process, and the welding procedure.

In addition to creating residual stresses, the fusion welding process also produces metallurgical changes in the parent metals adjacent to the weld. The effect of these metallurgical changes on the service requirements of the joint is dependent upon the type of materials welded, the welding process employed, and the purpose for which the part or structure welded is to be used.

Most annealing operations are employed as a means of relieving residual or locked-up stresses, with no attempt to produce a metallurgical change in the joint. The value and need of strain-annealing some welded structures is open to question, because of a decided lack of knowledge regarding the effect of residual stresses on their service life. Some welding codes consider strain-annealing mandatory on certain classes of structures (see American Society of Mechanical Engineers' Boiler Construction Code for Fusion Welding, and page 129 of the 1935 edition of the American Tentative Standard Code for Pressure Piping sponsored by the American Society of Mechanical Engineers), while others consider it a form of insurance and permit the use of higher joint efficiencies when it is used. (See American Petroleum Institute—American Society of Mechanical Engineers' Code for Unfired Pressure Vessels, 1934 edition.) In such cases, it is an easy matter for the designer to determine whether or not a structure should be strain-annealed. In the construction of welded machinery and miscellaneous equipment, however, it is often difficult to determine whether strain-annealing is advisable or necessary.

Kinds of Welded Work for which Annealing is Advisable

It is impossible to establish a definite set of rules to determine whether or not a structure should be annealed, but there are certain requirements that will serve as a valuable guide.

1. In general, statically loaded structures and structures composed of light sections, non-rigid connections, and members containing only a small amount of welding *need not be strain-annealed.* Buildings, bed plates, housings, tanks, certain classes of pressure vessels, motor frames, etc., are typical structures of this class.

2. Work that requires accurate machining and that must not become distorted during its service life *should be annealed.* The non-uniform distribution of residual stresses in welded work may cause it to become distorted during machining or warp later as a result of the redistributing of the stresses. Jigs, fixtures, lathe and planer beds, etc., are structures of this class.

3. Parts subjected to dynamic loads *should, in general, be strain-annealed,* because experience has shown residual stresses to be more serious for loadings of this type than for static loadings. Rotors for electrical machinery, Diesel engine crankcases, gears, etc., are in this class. There are some outstanding exceptions in this class of structures, such as bridges, freight cars, locomotive cabs, etc.

The latter are generally composed of thin plates or long members containing small amounts of welding; consequently, they can be considered as belonging to the first classification.

4. Structures composed of heavy or large parts and containing large amounts of welding should preferably be annealed, because they generally contain large residual stresses. The Boulder Dam cylinder gates for the intake towers are a typical example of this class of structure.

From the previous classifications, it might appear at first sight that the major portion of all welded structures should be annealed. This, however, is not the case, because most of the structures fall within the first classification. The other classifications actually comprise only a small percentage of all welded structures.

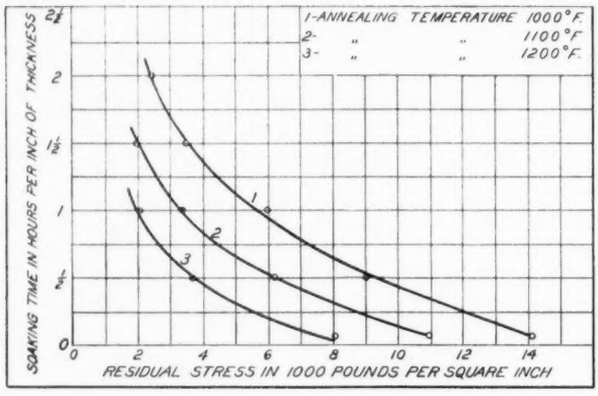


Chart Showing Results Obtained in Annealing Welded Test Plates for Different Periods of Time and at Different Temperatures

Method of Annealing to Relieve Strains

The process of strain-annealing consists essentially of slowly heating the structures or parts to a suitable temperature, allowing them to soak at this temperature for a definite period of time, and then slowly cooling them in the furnace. The annealing temperatures generally used range from 1100 to 1200 degrees F. (This temperature range has been established experimentally and is recommended by all welding codes.) These temperatures are not high enough to produce grain refinement, but they do have a tempering effect, which tends to increase the ductility of the weld and slightly lower the tensile strength. The tempering effect resulting from strain-annealing is often found beneficial in softening hard areas adjacent to the weld, thereby facilitating machining operations.

The theory of strain-annealing to relieve residual stresses is dependent upon three things: First, within certain limits of strain a ductile metal will not develop a stress greater than its yield point; second, the yield point of metals decreases at high temperatures; and third, the phenomenon of creep, or plastic flow, takes place at high temperatures. (See "The Relief of Welding Strains by Annealing," by Charles H. Jennings, Journal of the American Welding Society, Vol. 10, No. 9, September 1931, page 26.) The function of these factors during the annealing operation is best explained by an example.

Assume that a welded structure containing residual stresses close to the yield point (30,000 pounds per square inch) of the parent metal is to be annealed at 1100 degrees F. When the temperature of the structure increases above 600 degrees F., the yield point of the material decreases. Also, because the metal will not develop a stress greater than the yield point, provided the amount of plastic strain is small, the residual stresses will also decrease. When the annealing temperature (1100 degrees F.) is reached, the remaining residual stress will be approximately 12,000 pounds per square inch, which is the yield point of the parent and the welding metals at this temperature.

If the structure is cooled uniformly immediately after this temperature is reached, the final residual stress will be 12,000 pounds per square inch. If, however, instead of cooling the structure immediately after it has reached the annealing temperature, it is allowed to soak at this temperature, the phenomenon of creep occurs, and the metal flows plastically, thus further reducing the residual stresses. The longer the soaking time, within limits, the lower the final residual stresses will be.

Test data obtained on welded test plates (see article by Charles H. Jennings, previously referred to), subjected to different annealing temperatures and different soaking times are given in curve form in the accompanying diagram. These data show that residual stresses, regardless of their initial values, can be reduced to a negligible amount and that their final value decreases as the annealing temperature increases and the soaking time increases.

Higher annealing temperatures than 1200 degrees F. can be used, but they introduce the problem of excessive distortion, and consequently are seldom used unless required to produce metallurgical changes in the weld or the heat affected areas.

Type of Furnace Required for Annealing

The annealing process may be carried out in many types of furnaces. These furnaces may be electrically heated, gas heated, or oil fired. In some cases, annealing has even been done in temporary furnaces heated with coke. A large electrically heated annealing furnace of a type that has proved very satisfactory for the annealing of welded structures is shown in the heading illustration.

When a structure is being annealed, it should be adequately supported to prevent warpage, which may easily occur as a result of the reduced strength of the material at high temperatures. The decreased strength of steels at high temperatures may also be employed to straighten warped structures by properly supporting and weighting them,

so that they will sag into the desired form during the annealing operation. This straightening process will not harm the strength of the structure in any way.

The procedure of strain-annealing may vary considerably without greatly influencing its effectiveness. The greatest variations are in the rates of heating and the temperature at which the structure may be removed from the furnace. Some authorities recommend a rate of heating not to exceed 140 degrees F. per hour, while others recommend a rate of heating of 250 degrees F. per hour, or more. The need for extremely slow heating and cooling is obviously more pronounced in annealing structures containing members of widely different thicknesses.

The recommended temperature for removing the structure from the annealing furnace varies from 200 to 400 degrees F. Here, again, the deciding factor is the relative thicknesses of the component parts and the design of the structure.

A satisfactory annealing procedure for ordinary welded work made of low- or medium-carbon steels is as follows:

Preparation—Place the welded work in the furnace so as to have the maximum area of surface exposed. Support the structure properly, so that it will not become distorted during the annealing operation.

Heating—The temperature of the furnace should not exceed 300 degrees F. at the time the work is placed in it. Heat the work to 1100 to 1200 degrees F. at a uniform rate not to exceed 200 degrees F. per hour.

Soaking Time—Allow the work to soak at the annealing temperature for a period of at least one hour per inch of thickness of the thickest plate that is welded.

Cooling—Let the work cool slowly in the closed furnace. Below 300 degrees F. the structure may be removed from the furnace and allowed to cool to room temperature in a still atmosphere.

In cases where it is not practicable to anneal the complete structure, annealing of individual joints or parts may be carried out. The annealing of welded joints in high-pressure pipe lines is a typical example. Whenever sectional annealing of a structure is carried out, it is essential that its design be such that the local heating will not produce objectionable residual stresses in other parts of the structure.

Annealing to Obtain Desirable Metallurgical Changes

In addition to the relief of residual stresses, annealing is sometimes employed to produce corrective metallurgical changes in the welded joints. The annealing temperatures in such cases depend upon the materials the structures are composed of and the nature of the corrective changes desired. Hence, no uniform recommendations can be given as to the annealing temperature, the soaking time, or the cooling rate. The rates of heating specified for strain-annealing, however, will generally be found satisfactory.

The welding of medium-carbon steels (0.30 to 0.45 per cent carbon) and certain alloy steels will generally produce hard areas adjacent to the weld, unless preheating or special welding procedures are used. In such cases, machining of the welded joint may be difficult. Strain-annealing at 1100 to 1200 degrees F. will usually soften these hard areas and thus facilitate machining. Annealing temperatures of 1300 to 1450 degrees F. will further soften the hard areas, but will increase the problem of distortion.

Annealing and Age-Hardening Alloy Steels Containing Copper

Some alloy steels containing copper as an alloying element may be annealed and age-hardened to improve their physical properties. (See A. E. Gibson on "The Development and Use of Low-Alloy High-Tensile Steels," Journal of the American Welding Society, Vol. 14, No. 9, September 1935, pages 2 to 8.) The increase in strength obtained will depend upon the annealing temperature, the greatest strength being obtained with an annealing temperature of about 950 degrees F. As the annealing temperature increases to 1650 degrees F. the tensile strength is reduced, but the ductility is increased.

Welded straight chromium steels of the 4 to 6 per cent and the 16 to 18 per cent grades contain brittle welds and brittle areas adjacent to the welds as a result of the metallurgical changes resulting from the heat of welding. The ductility of the welds and these brittle areas may be greatly increased by proper annealing.

The maximum softness of the weld and the heat affected zone of 4 to 6 per cent chromium steels is obtained by a full anneal at 1600 degrees F., followed by a slow furnace cooling (about 50 degrees F. per hour) until a temperature of 1200 to 1300 degrees F. is reached. Below this temperature the structure may be air-cooled. The recommended annealing practice for restoring ductility to welded joints in 16 to 18 per cent chromium steel consists of heating to 1450 to 1500 degrees F., followed by slow cooling to at least 1100 degrees F.

The welding of certain grades of 18-8 (18 per cent chromium, 8 per cent nickel) stainless steels produces carbide precipitation which seriously affects the resistance to corrosion. Proper annealing, however, will restore the corrosion resisting properties. The recommended annealing procedure for this type of alloy is to heat slowly to 1900 to 2100 degrees F., followed by rapid cooling.

In all of the previous examples, it will be noted that the annealing temperatures required for metallurgical changes are above the requirements for strain-annealing; consequently, whenever the desired metallurgical changes are obtained, the strain-annealing effect is also produced.

What is Meant by "Climb-Cut" Milling?

A Brief Explanation of a Method of Milling that Differs from the Conventional Practice, Together with an Outline of Its Advantages

By K. H. CRUMRINE
Sterling-French Machinery Co., Detroit, Mich.

MILLING cutters are generally subjected to a form of duty more difficult than that of any other type of metal-cutting tool. Hence, the useful life of milling cutters between sharpenings is always less per cutting edge than that of other metal-cutting tools; and, although the milling cutter as a whole has appeared to be highly efficient, the multiplicity of cutting edges has obscured the short life per tooth.

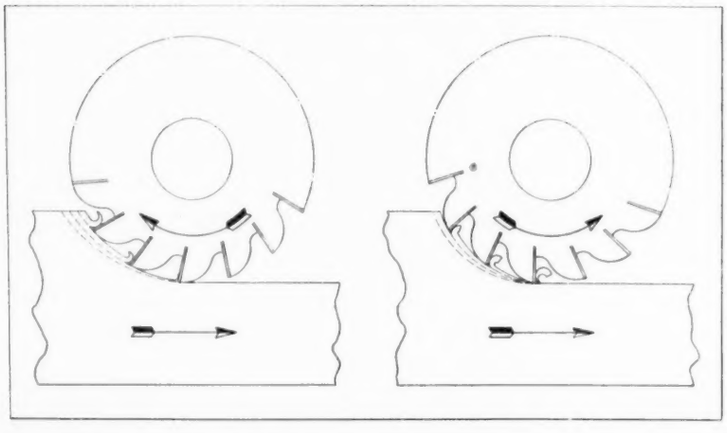
Any metal-cutting tool has partly a cleaving action and partly a frictional abrasive action, the latter being due to the resistance of the metal to the cutting action. It is the frictional abrasion that causes tools to fail. The abrasion causing failure is that occurring on that portion of the cutting edge which contacts the surface immediately resulting from the chip being taken. Abrasion at this point may be greatly increased or decreased by conditions that can largely be controlled, thereby affecting the useful life of the tool. To decrease the abrasion to the minimum, it is necessary to move the cutting edge *exactly in its intended path of travel,* or as nearly so as possible.

The intended path of travel may be a perfectly straight line, as in a planer tool; a perfect helix or spiral, as in a lathe; or a perfect circle, the center of which moves exactly in a straight line, as in a milling machine. The exact path of travel as intended permits of no vibration. The ideal condition, therefore, is obtained only when both work and tool are rigidly held. On this depends, to a great extent, the useful life of any cutting edge.

The so-called "normal" type of milling is to mill against the feed of the work. This makes it necessary for each cutting edge to enter the cut at a zero chip thickness. The cutter tooth first comes in contact with the metal, then rubs against it for a certain distance, depending on the hardness of the metal and the rigidity of the cutter and work-support, and finally picks up its chip and actually cuts. The process would be analogous to frequently engaging and disengaging the feed of a lathe, causing the tool to enter and leave the cut many times as it proceeds. This, of course, would shorten the life of the lathe tool. It also shortens the life of the milling cutter tooth, as a direct result of the tooth not moving in its exact intended path of travel.

It is now becoming recognized that the process known as "climb-cut" milling, or milling with the feed instead of against it, has definite advantages on many types of milling. In "climb-cut" milling, the cutter is reversed and the direction of rotation is reversed, while the direction of table feed remains the same. In "normal" milling, the table feed and the cutter rotation are in opposite directions. In "climb-cut" milling, they are in the same direction. Under these conditions, each cutting edge enters the metal at the top of the cut or at the point of greatest chip thickness. Each tooth enters like a planer tool, definitely cutting with a minimum of abrasive action. In other words, the tooth is enabled to follow its exact intended path more closely.

To meet the last requirement, however, it is obvious that "climb-cut" milling demands that the machine shall not permit the cutter to climb into the work faster than is intended. The table construction must make it possible to resist cutting forces from either direction positively and without flexure. Furthermore, the process requires that the milling



Diagrams Showing, to the Left, Ordinary or Normal Milling, and to the Right, "Climb-Cut" Milling

machine table always move in a straight true path of travel, that the cutter-arbors be of unusual size, and that the cutters be closely fitted. Outboard arbor supports without play and a rugged spindle drive are essential.

Experiments in hobbing gears by the "climb-cut" method have recently been conducted that are said to have been very successful, resulting in greatly increased cutter life, smoother finish, and more accurate tooth forms.

Briefly, the advantages of this method of milling are that the usual cutter life may be increased from two to ten times with greatly increased speed and feed rates; that the work-holding problems are greatly simplified or entirely eliminated; that the milled surfaces have the appearance of being cleanly cut rather than burnished; and that in cutting slots and keyways no burrs are produced. "Climb-cut" sawing operations produce surfaces that can be used as satisfactory joints without further finishing. When the joints are laid together, no light can be seen through them.

Of these advantages, the increased cutter life is perhaps the most outstanding. It will be found that the harder the material being cut, the greater is the difference in this respect between normal and "climb-cut" milling. This is because, in normal milling, the greater resistance of the harder metal causes each cutting edge to ride on the metal for a greater distance before picking up its chip.

Next in importance is probably the simplification of holding-down problems. In "climb-cut" milling, the cutter pushes the work down rather than picks it up. It has been found practicable to mill many parts without any clamping down, providing only against end and side movements of the work.

Eliminating Cracks in Hardened Dies

By HECTOR J. CHAMBERLAND

IF it were possible to determine, immediately after the heat-treatment of a die, whether the heat-treatment had caused any defects, much time could be saved and many controversies between the departments concerned would be avoided. With modern heat-treating and grinding equipment, no trouble should be experienced from the development of cracks in hardened steel. Any up-to-date heat-treating department should be able to adhere strictly to the steel manufacturer's recommendations. On the other hand, if the heat-treating facilities are not adequate, the dies should be sent out to companies specializing in this particular line of hardening.

If a die that has been correctly hardened and is free from defects develops a fine network of cracks during the grinding operation, the trouble may be laid to one of two things. Either the operator lacks the necessary skill or the grinding wheel is not suited for the delicate grinding operation. (This article relates to dry grinding.)

The most commonly used steels that develop cracks during the grinding operation are high-speed steels, those of high carbon and chromium content, and tungsten-chromium steels. The operator who grinds dies should bear in mind that a wheel of unsuitable grade, grain, or structure can generate enough heat to damage or ruin the part being ground.

In some cases, the work will stand considerable abuse from the improper use of an unsuitable grinding wheel without developing serious cracks; but sometimes trouble starts with minute seams which are hardly noticeable to the naked eye. Whether these seams will ultimately result in serious trouble depends to a large extent on the care with which the operator performs the grinding operation.

Only wheels that are recommended for grinding dies should be used. These wheels should be stocked in sufficient quantities to avoid having to use a wheel that is too hard for the work. It is a safe procedure to use a wheel for dry grinding that is one grade softer than that recommended for wet grinding. The surface speed of the wheel should be kept at or near its maximum. If the surface grinder spindle operates at a speed that will give a wheel 7 inches in diameter the required surface speed, the wheel will lose much of its cutting efficiency when worn down to a diameter of 6 inches, and should be replaced or the spindle should be speeded up.

For high-speed, high-carbon and chromium steels, the depth of cut should not exceed 0.001 inch, and the traverse feed should not be greater than 0.020 inch per revolution. Because of the heat-resisting characteristics of tungsten hot-die steels, the depth of cut for this material may be as much as 0.002 inch and the traverse feed can be increased accordingly.

A wheel of No. 5 structure will produce a finer finish than a wheel of No. 10 structure, because the grain spacings of the former wheel are closer. To some extent, the variation in steel structure affects the grade, and sometimes the wheel life can be increased by using a different structure without sacrificing results. For example, for surface-grinding hot-steel dies, a grade I-8 structure would perform as well as an H-5 structure on high-speed steel, but the I-8 wheel would last longer.

The Fundamentals of Industrial

The Link-Belt Co. Holds that Apprentice Training Should not be Only Trade Training—It Should Teach not Skill Alone but the Business of Industry as a Whole

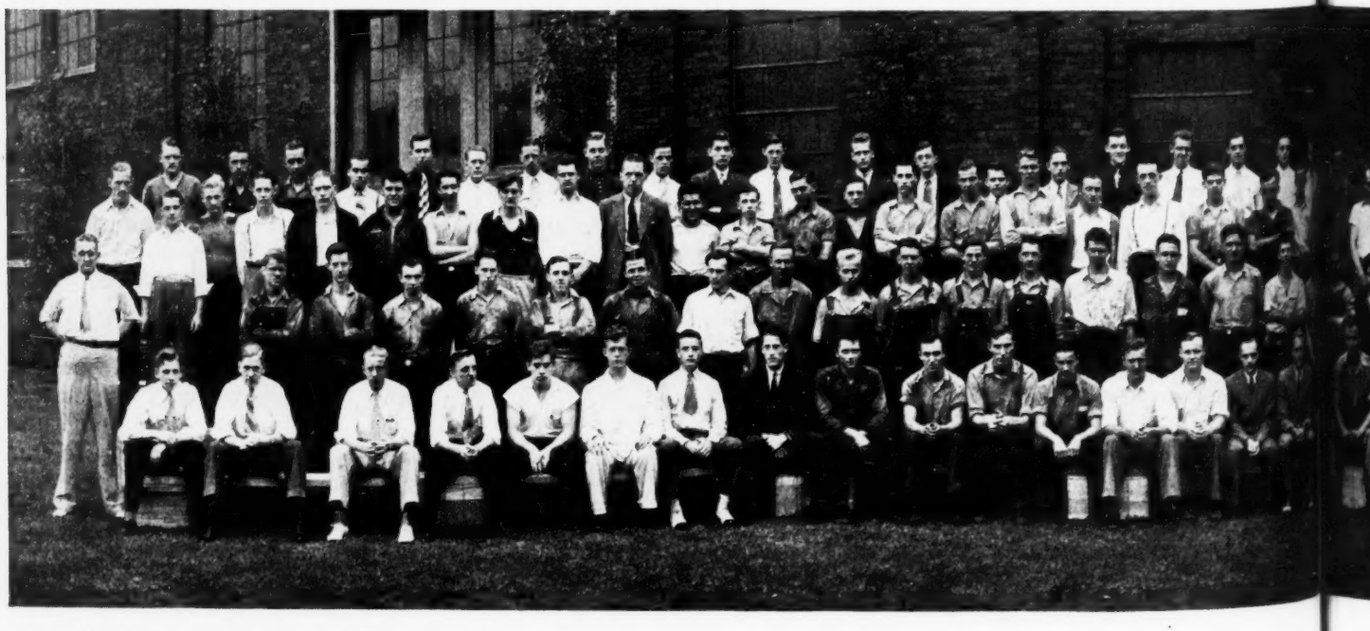
E. L. Berry

THE objective of the apprentice courses maintained by the Link-Belt Co. involves more than mere trade training. The executives of this company hold that what is needed in industry is more than manual skill and the ability to operate machines. They believe that an important part of the training of young men for industrial work consists in making them cost-conscious—thereby increasing their sense of responsibility. Furthermore, they believe that the young men must and should be taught how to cooperate and work with their fellow-workers, how to make friends with those working with them, and how to understand and appreciate the other fellow's point of view.

The objective in the minds of those who supervise the training should constantly be focussed on the work that these young men will be called upon to perform some day. Most of them will become supervisors of other workers. In that capacity, perhaps 75 per cent of their value depends upon their attitude to their firm, their fellow-workers and their work, their cooperative ability, and their personal qualities, as considered apart from their trade skill.

It should constantly be borne in mind in devising any apprentice training plan that the training is not for today but for tomorrow, and that while the immediate objective is to develop high-grade mechanics, the ultimate objective is to develop men who will eventually be able to qualify for supervisory jobs.

After the right young men have been selected for the training course, the secret of success with any apprentice system depends largely upon how they are handled. The management and those in charge of the training must show a friendly attitude toward them and give them a great deal of attention. The supervisor's motto should be "Let the boys know that you know that they are around." Talk their problems over with them. Help them and advise them as much as possible. The effect



Training

By E. L. BERRY, Assistant General Manager Link-Belt Co., Chicago, Ill.

of this will be noticed in the interest that the young men will take in their work.

Furthermore, the object of a training course should be to make it possible always to make promotions from within the organization. When this policy of a firm becomes known to the apprentices, they have something definite to work for. They can begin to look ahead—quite far ahead.

The Selection of Young Men for Training Courses

The young men are selected with the utmost care for the Link-Belt training courses. No employer can afford to pay for failures. Boys are not taken directly from school into the apprentice course. They always work in the plant for some time before their apprentice training actually begins—never less than three months, and frequently several years. Many boys work in the plant during the summer while still going to high school.

In this way, practically every boy entering the course has a clear idea of the trade that he is planning to learn, and, at the same time, those supervising the apprentice training have a fairly good knowledge of the boy before he starts on a definite course. Many of the apprentices are sons of men already working in the plant, which is an additional advantage and tends to create a spirit of closer cooperation.

Types of Courses Maintained

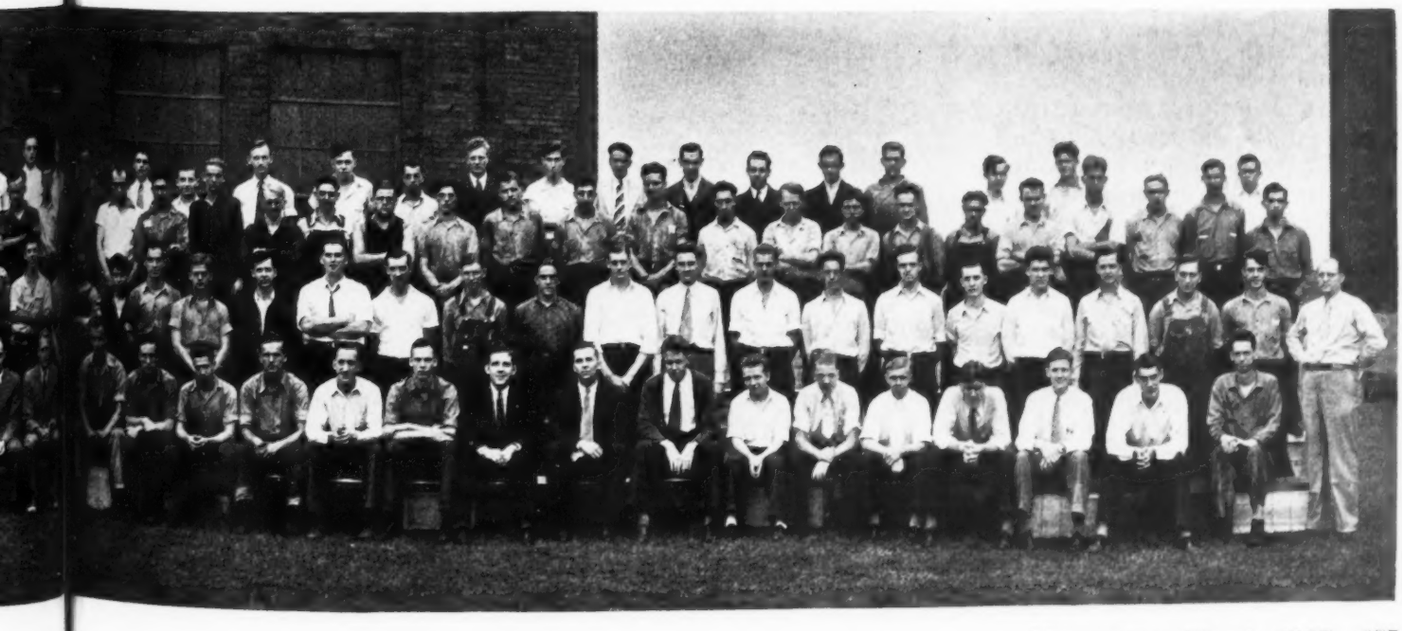
The management maintains that, although the planning of the courses themselves is of great importance, the principles laid down in the foregoing paragraphs largely determine the success of an apprentice system. In other words, the training and the system must be broader than a mere program of so many years, divided into work of so many weeks in each department. Nevertheless, a great deal of thought and study has been given to the planning of the actual courses.

There is a regular four-year apprentice course, the object of which is to develop high-grade mechanics. For those graduating from this course who show special aptitude and ability, an additional three years of planned training is provided while they perform their regular duties in the plant. Their work will be in the time study or production departments; and in the engineering department. At the end of the three years they should be fitted to take jobs as supervisors and to hold minor mechanical executive positions.

For those having graduated from engineering schools, a two-year course is provided with a view to fitting them for future engineering and sales work.

The young men in the regular apprentice course are expected to devote a portion of their time to their technical training. One day a week during the first two years is spent at the Washburne School, which is conducted under the auspices of the National Metal Trades Association. Here they receive instruction in drawing and mathematics.

A Group of Young Men Being Trained at the Link-Belt Plant in Chicago to Take Their Place in the Mechanical Industry



For the time spent in this school, the company pays the boy for an eight-hour day at his regular rate of pay. It is also expected that the young man will continue night school work along engineering lines after his two-years' course at the Washburne School has been completed. The company furnishes to the apprentices technical text-books relating to the best trade practices.

The Cost of Maintaining an Apprentice System

Many employers who are contemplating the training of apprentices are afraid to embark on this enterprise because they believe that the cost will place a heavy burden on their business. If the apprentice course is carefully planned, if the right kind of young men are selected for the course, and if they are given the proper supervision, there is no need for apprehension in this direction. The earnest apprentice will perform conscientious and worthwhile work and will earn his way. As he progresses in his training at the Link-Belt Co., he is given piece work. In that way, his earning capacity is definitely measured, and while he is learning a trade that will give him a chance to progress throughout his life, he is also earning his own living and fills a place with the company that employs him. Any apprentice training course that cannot be made to pay its way is not properly planned.

In conclusion, let it be said that the right kind of plant will find no difficulty in obtaining the right kind of young men to train. The average American boy is willing to learn and to work if he is given the right kind of chance. It is the job of industry to pay attention to that kind of boy. The depression has actually helped to bring out qualities in these young men that were frequently missing in the men of their age ten years ago. The Link-Belt Co.'s apprentice system is based upon faith in the American boy, and such faith is necessary, because it is upon these boys that the industry of tomorrow must depend for its success.

Fiftieth Anniversary of Kane & Roach, Inc.

THIS year the business known as Kane & Roach, Inc., Syracuse, N. Y., celebrates its fiftieth anniversary. The business was started in 1887 as the Monarch & Eureka Co. by W. E. Kane, who is still president of the company. Mr. Kane was only twenty-one years old at that time, but he was not without business and mechanical experience, because, ever since he had been fifteen years old, and while still in school, he had run a little repair shop to which neighbors brought lawn mowers to be fixed and skates and shears to be sharpened. At the age of sixteen he left school and worked as an apprentice for three years with Heald & Morris, predecessors of the Morris Machine Works at Baldwinsville, N. Y., makers of centrifugal pumps. Shop hours were from seven in the morning until six at night, but in spite of the long working day, young Kane found time to study physics and geometry before and after work.

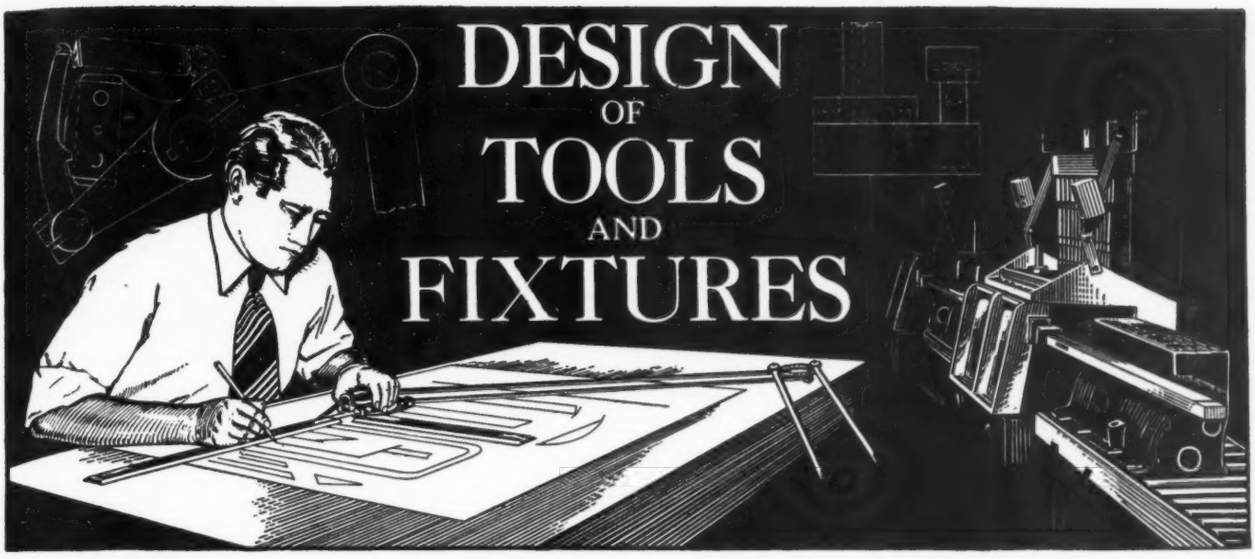
W. E. Kane, President and Treasurer of Kane & Roach, Inc., Who Fifty Years Ago Founded the Business that He Still Directs

Associated with Mr. Kane as a salesman at the very start of the business was his brother-in-law, B. F. Roach. In 1891 Mr. Roach was admitted to partnership. The firm of Kane & Roach continued until Mr. Roach's death in 1900; later the firm became Kane & Roach, Inc. Three times the business had to seek larger quarters, until in 1898, the first of a group of manufacturing and office buildings was erected on the site of the present plant.

In the early days, much of the business consisted in building equipment for the carriage and wagon trade, but later equipment for the steel industry became one of the main products of the firm. Through the long span of half a century, Mr. Kane has designed and manufactured a varied line of machines of many different types, but his three major mechanical developments are straightening machines, cold-roll forming machines, and wrapping type benders. Each of these machines was the first of its type to be placed on the American market, and these three types have formed the backbone of the Kane & Roach business. The straightening machine was placed on the market forty-four years ago; the cold-roll forming machine, forty years ago; and the wrapping type bending machine, over thirty years ago.

* * *

In thirty-three countries outside of the United States, employment is now above the 1930 level.



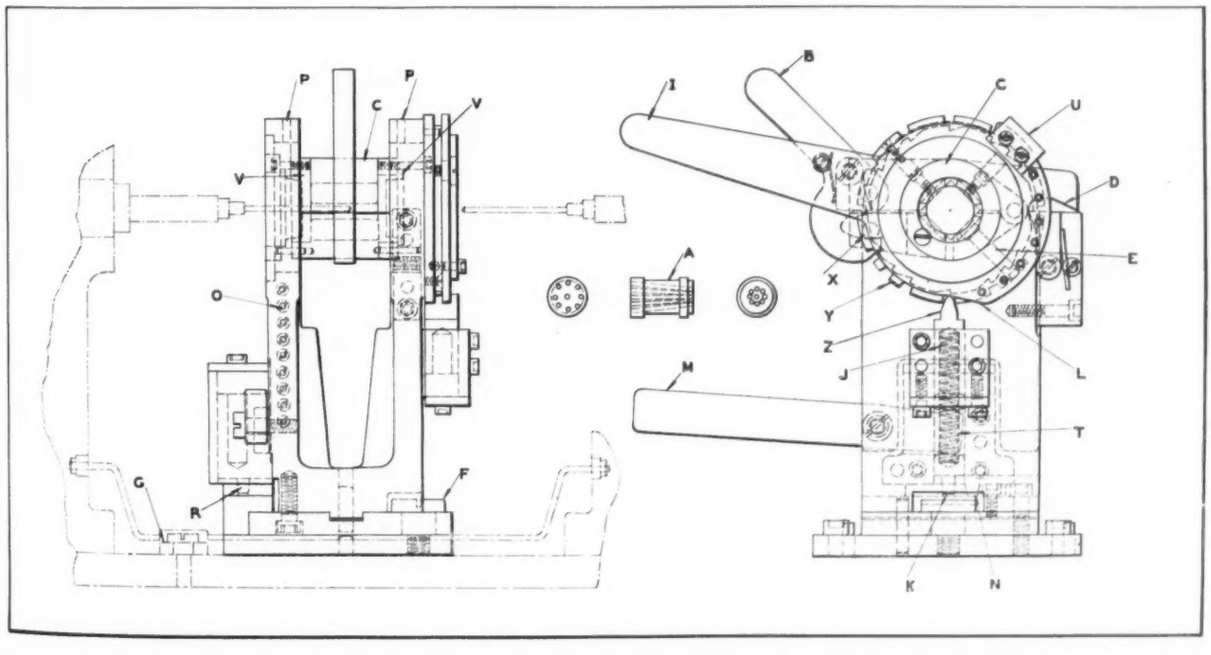
Indexing Fixture for Drilling Evenly Spaced Holes at Angle with Central Hole

By HERBERT BOSCH, Hillside, N. J.

The fixture shown in the accompanying illustration was designed, after conducting the necessary experimental work, for drilling evenly spaced holes at an angle in the part shown at *A*. The axis of the central hole is perpendicular to the end faces, while the axes of the remaining holes are at an angle with the faces. Four, six, eight, or sixteen holes can be drilled, besides the central hole.

The part A to be drilled is inserted in the clamping arrangement *C* and locked in the drilling position by pulling down lever *B* as far as it will go, the travel of this lever being limited by pin *X*. Part *A* is then ready to have the central hole drilled. Lever *G*, shown by dot-and-dash lines in the view at the left, is now moved to one side by the operator. This brings two semi-automatic horizontal drilling spindles into operation. The movement of the drilling spindles is such that when one drill enters part *A*, the other is being backed out. Each drill is thus advanced just beyond the middle of the piece. The drill presses are arranged to regulate the drilling operation automatically, moving forward in successive stages and stopping at regular intervals to allow the drills to recede in order to clear the chips.

After the central hole of the piece has been drilled, lever *M* is pushed downward against the



Fixture Designed for Drilling Central Hole and Evenly Spaced Angular Holes in Part A

retaining pressure of spring *J*. This releases the locking tooth *R* from notch *K*. Lever *M* is then moved sidewise until tooth *R* slides into notch *N*. During this movement, the fixture pivots about the screw *F*. This results in locating the fixture in the proper position for drilling the angular holes.

Now lever *G* is again pushed to the side, setting the drill presses in motion for drilling the first of the angular holes. When the first hole has been completed, lever *I* is moved clockwise until its motion is stopped by the adjustable stop-block *U* coming in contact with the tooth *Z*. At the same time, the cam or circular extension *L* on lever *I* pushes the tooth *Z* downward against the retaining pressure of spring *J*. This allows dial *Y* to move to the next open locking slide. Lever *I* is then moved counter-clockwise until it reaches its original position. The rotating part of the fixture is now properly located for drilling the next angular hole. These operations are repeated until all the angular holes have been drilled.

After the angular holes have been drilled, lever *B* is released. The upper part of the clamping device *C* is then moved upward, and at the same time, the lower wedge *D* of the clamping device pushes against pin *E*, thus rejecting part *A* from the holder.

The number of angular holes to be drilled is determined by the setting of stop-block *U* on the extended portion of lever *I*. The dial *Y* and the ratchet are provided with the required number of notches and teeth. The notches on dial *Y* that are not in use are made blind or inoperative by using the screws *O*, for which a nest is provided on the front of the fixture.

If sixteen holes are required in part *A*, the latter will be of somewhat greater length and diameter than the part illustrated. The clamping mechanism can be removed from slides *P* and a different sized clamp inserted. The drill bushings *V* can also be removed and replaced by bushings of the size required to suit the number of holes to be drilled.

Die for Blanking Out Evenly Spaced Slots in Refrigerator Grids

By F. SERVER

A flat plate grid containing seven rows of slots, each consisting of twenty-one perforations, as shown in Fig. 2, is used in refrigerator units. Each row contains slots as indicated in the first row. The numerals along the top edge designate the various rows. For perforating these grids, a die of the type shown in Fig. 1 is employed. This die comprises a base *A* on which are built up hardened steel sections in such a manner that seven slots out of the twenty-one in each row are pierced at a time, while by the simple expedient of replacing the work-locating back-plate *B* by a narrower plate, a second group of slots is pierced; then, by using a third and still narrower back-plate at *B*, the remaining slots are pierced in the grid.

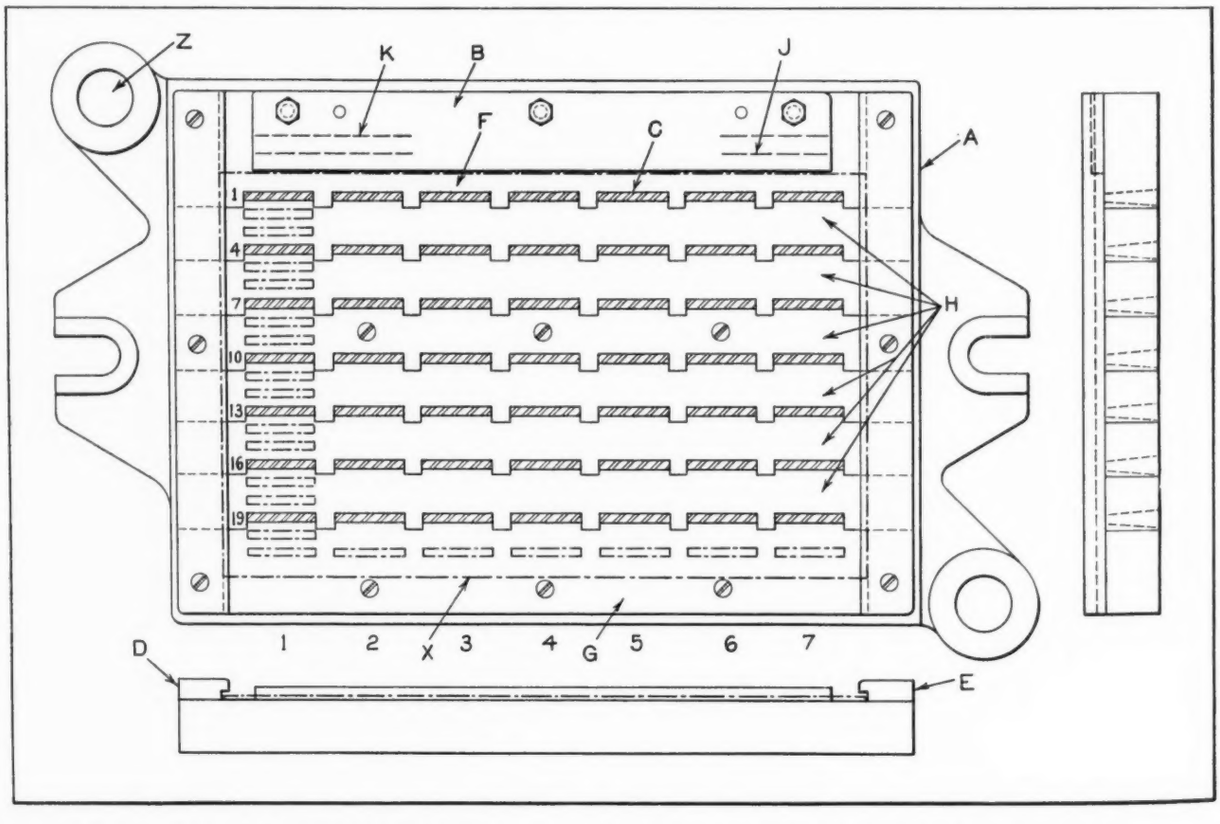


Fig. 1. Die with Forty-nine Punches which Pierce 147 Slots in Three Strokes in the Grid Shown in Fig. 2

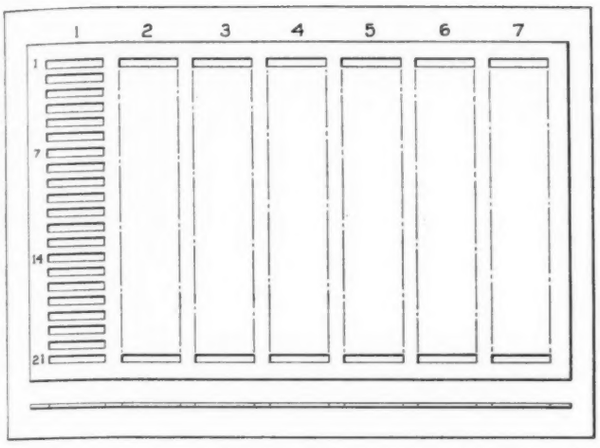


Fig. 2. Refrigerator Grid Unit Having 147 Pierced Slots

This method is used to simplify the die construction and to give it sufficient strength between the die holes. A flat blank *X* is set in the die with its back edge against plate *B*. Each rectangular section *C* represents a piercing punch. The seven numerals reading from left to right correspond with the seven numerals in Fig. 2, and the numerals along the left edge of the die indicate where the perforations come with relation to the numerals along the left edge of the grid shown in Fig. 2.

The blank is slid in place under the side guides *D* and *E*. The cutting portions of the die consist of a rear steel section *F*, a front steel section *G*, and six steel sections *H* which are identical in construction. These sections interlock at the slots, and are held by screws and dowels to the base of the die, which works in combination with a punch provided with spring pads, as shown in Fig. 3. This illustration represents one corner only, the guide post *Z* being the same in both Figs. 1 and 3.

The punch-holder is indicated at *A* in Fig. 3. Each of the forty-nine punches *B* is attached by a screw *C* and two dowels, the punch for each slot in the grid being individually mounted and alike in all instances. Between each row of punches is a spring plate *D*, three of which are shown. These are attached to the holder by means of screws *E* having springs around them. The screws are free to slide up and down in the holder so that as the punch descends the springs are compressed. As the punches rise, after making the perforations, the spring plates automatically strip the grid off the punches.

One stroke of the punch press pierces the line of holes at 1, 4, 7, 10, 13, 16, and 19, as indicated in Fig. 1. After completing all the grids to be pierced, the back locating plate *B* is removed and a narrower one having its front edge at *J* is put in position; then another seven lines of holes are pierced with the grid located against this edge. By following this up with a back plate having its front edge at *K*, the remaining seven lines of holes in the grid are pierced, thus completing the perforating.

The die is of simple construction, being built up of sections which are easy to replace and which are strongly constructed across the slot corners. The combination of the spring stripper plates and the side guides *D* and *E*, which reach over the edges of the stock, insures that the work will be stripped cleanly from the punches.

Efficient Equipment for Washing Drill Jigs

By F. MUIR, Hamilton, Ont., Canada

The oil or cutting compound used when drilling steel causes the chips to stick to the jig and makes it difficult to remove them with a brush. Small jigs are best cleaned by dipping them in warm water in which some kind of cleaning compound has been dissolved. Metal buckets supported on stands are the usual means adopted for washing jigs. If oil or a near-oil compound is used as a cutting agent, the contents of the bucket will become fouled after the jig has been washed a few times and oil or fine chips will be seen still clinging to the locating faces unless the jig is given an extra vigorous swishing about.

Two buckets close together will give better service if one is used for rough-washing and the other for finish-washing. A quick swish in each bucket cleans the jig thoroughly and the buckets do not have to be changed nearly so often; in fact, not until they are cold. A jig cannot be properly

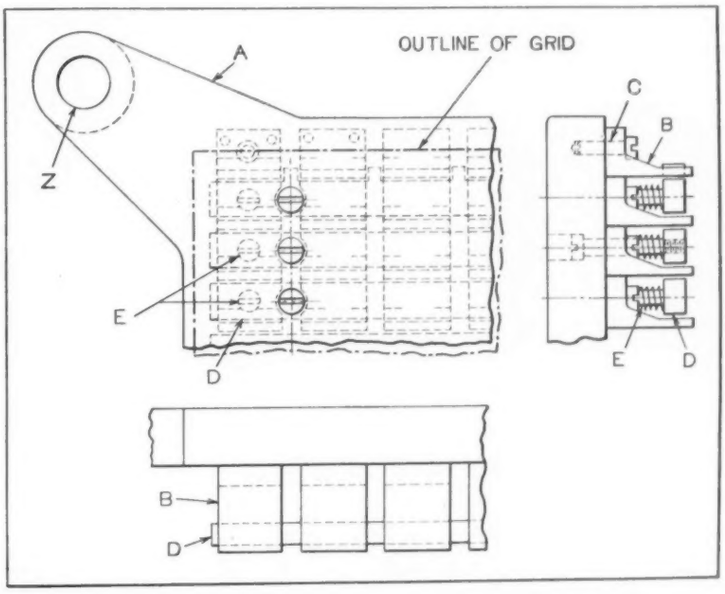


Fig. 3. Section of Punch Used with Die Shown in Fig. 1

cleaned if the contents of the bucket once become cold. Some operators drape a cloth over the top of the bucket to keep the cleaning bath warm. This is worth while if the jig is only washed at rather lengthy intervals.

Little attention seems to have been given to the design of the support for the bucket. A sheet-metal stand into which the bucket is dropped or a table to support it is the means generally used. There ought to be some means of adjustment for height, so that the top of the bucket will always be level with the drill press table. It is a great convenience to be able to slide the jig along the table right into the bucket instead of lifting it up or down a foot or two. It should be an easy matter to design an adjustable holder for two buckets, with an automatic cover that would slide out of the way when the jig is dipped in.

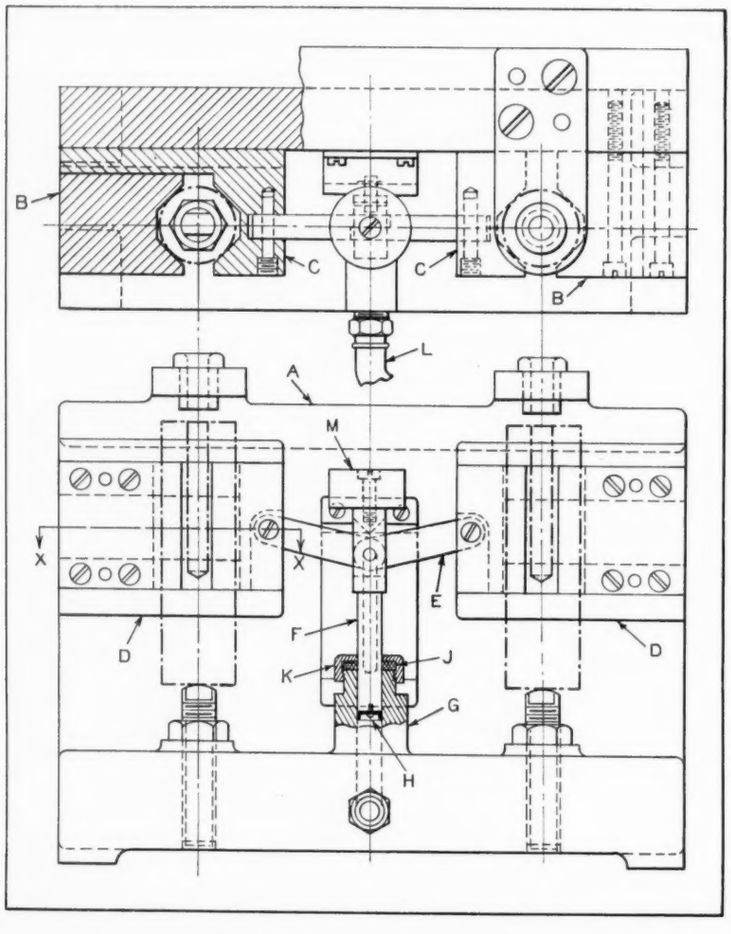
Air-Operated Tandem Drill Jig

By JOHN A. HONEGGER, Bloomfield, N. J.

In plants where compressed air lines are part of the equipment, much faster loading and unloading of jigs and fixtures can be accomplished if the clamps are operated by compressed air. The tandem jig here illustrated is a typical example of air-operated jigs employed in one plant. Two cylindrical pieces, indicated by heavy dot-and-dash lines, are drilled at the same time in this jig. The stationary V-blocks *B* are fastened to the base *A*, in which V-blocks *C* are sliding fits. These sliding blocks are also supported by machined guide pads *D* which are part of the base *A*.

The sliding V-blocks *C* are actuated by the toggle links *E*, connected to the central actuating piston *F*. This piston slides in the air chamber *G*. A leather packing *H* at the end of piston *F* prevents the compressed air from escaping. An additional leather washer at *J* is held in place by the threaded collar *K* which can be adjusted to prevent air from escaping at this point.

A foot-treadle is used to operate the air valve connected to the air line *L*. When the valve is opened to the atmosphere, the weight *M* on top of the piston *F* forces the piston to recede, causing the toggle *E* to collapse. This withdraws the sliding vees to permit the removal and insertion of work. The operator can insert two pieces of work simultaneously and hold them in place while the sliding vees are being closed.



Jig with Air-operated Clamps Controlled by Foot-treadle

* * *

Under a liberal government coercion is used only in order to create greater freedom. Like the traffic policeman, who uses his authority in order that traffic may move more freely, a liberal government uses its authority to suppress the few who interfere with the orderly processes of producing and exchanging useful products. When the traffic policeman, drunk with the sense of power, goes too far and uses too much authority, he impedes traffic. So those in higher government positions are sometimes tempted to use too much authority and impede the orderly processes of business, prevent the expansion of industry, increase unemployment, and start the country on the down grade.—*Dr. T. N. Carver in his book "What Must We Do to Save Our Economic System?"*

* * *

The wholesale value of all cars and trucks manufactured in the United States and Canada in 1936 was close to $2,450,000,000. In addition, parts and accessories for replacements were valued at $875,000,000, and the wholesale value of rubber tires for replacement at $300,000,000.

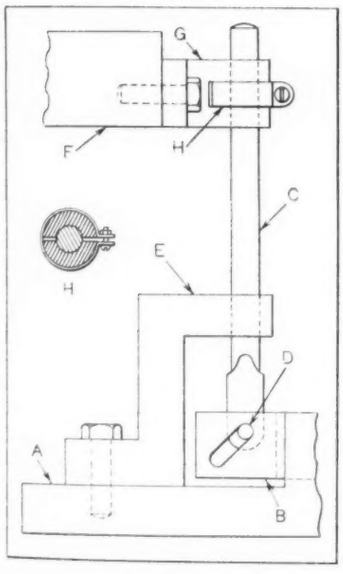
Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Using a Sliding Friction Collar to Shorten Stroke of Slide

A press tool for forming a wire product carried a slide that was required to have a short quick movement at the beginning of the down stroke of the ram, with a corresponding return movement at the beginning of the up stroke. The illustration shows the arrangement used.

The die *A* carries the slide *B* which is grooved on the back end to receive the plunger *C*. The slide also has an angular slot through which passes a pin *D* on the end of plunger *C*. The guide *E* maintains proper alignment of the working members, while the punch-holder *F* carries the bracket *G*, which is bored to receive plunger *C* and is slotted to take the friction collar *H*. Collar *H* is made from vulcanized fiber, which is split and held together with a clamping band.



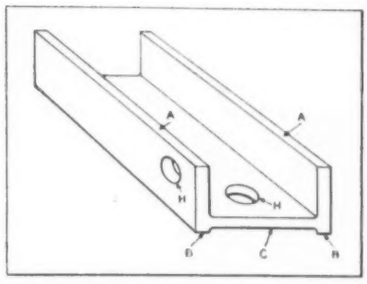
Friction Collar H Permits Transmitting Short Stroke to Slide B at Beginning of Stroke of Member F

When the ram descends, collar *H* forces plunger *C* downward, causing slide *B* to move forward, due to the action of pin *D* in the angular slot in the end of slide *B*. As pin *D* strikes the bottom of the slot, movement of slide *B* ceases and collar *H* slips on plunger *C* during the rest of the down stroke.

Philadelphia, Pa. L. KASPER

Drill Press Parallels Made from Channel Iron

In many shops, difficulty is experienced in keeping parallels in order and in their proper places near the drilling machines on which they are used to support work and to prevent drilling into the machine tables. Parallels made from channel iron, machined as shown in the accompanying illustration, will help overcome this difficulty. The parallels are provided with holes *H* so that they can be hung up near the machine or chained to it, the same as drifts used for removing drills from their sockets.



Parallel Made from Channel Iron

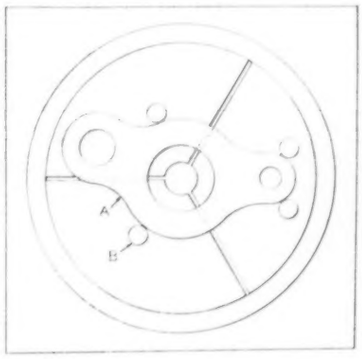
The surfaces *A* and *B* are machined parallel, and a clearance or relief is provided at *C*. The parallels may be made in various lengths, widths, and heights. A convenient size for the smaller drilling machines can be made from a piece of channel iron 6 inches long by 2 inches wide. Parallels of this type have been made in sizes up to 12 inches in length by 5 inches wide, with a height of 3 inches, for use on the larger size drilling machines.

Minneapolis, Minn. D. A. ROGERS

Chuck for Holding Thin, Non-Magnetic Parts Having Irregular Contours

Thin, non-magnetic parts, such as shown at *A* in the accompanying illustration, can be held on a split collet, as shown, by inserting pegs *B* in the three contracting segments. The pegs should be so located that the clamping pressure will be distributed as evenly as possible when the three jaws or segments of the chuck contract.

FRED HORNER
Bath, England



Chuck for Holding Work of Irregular Contour

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Collecting on Checks Not Immediately Cashed

D. W. T.—What is the liability of a seller who fails to cash checks within a reasonable time after receiving them? A few weeks ago we received a check as payment for a machine. This check was not deposited for several days, and when it was deposited it was returned marked "No Funds." Can we collect the amount of the check from the customer?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

Various courts have held that all persons should present checks to banks without delay. If, for instance, the bank on which the check is drawn fails, the holder of the check cannot recover from the maker, if he could have presented and received payment on the check within twenty-four hours after he accepted it. While it is not customary to do so, the courts require that the holder of a check present it immediately to the bank on which it is drawn. In other words, any delay caused by depositing the check in a bank different from the bank on which it is drawn, which results in the check having to go through a clearing house, is at the risk of the holder.

However, the fact that a check is returned marked "No Funds" does not prevent you from suing the customer and recovering the amount of the check. Your failure to deposit the check promptly does not relieve the debtor from payment, provided your negligence in not depositing it does not result in financial loss to the debtor.

The Difference Between Soldering and Welding and the Use of Silver Solder

L. M. S.—Please explain the difference between soldering and welding? Also, how is silver soldering done and what are its advantages as compared with ordinary soldering?

A.—The answers to these questions may be found in a paper read before the American Welding Society by R. H. Leach, manager, Handy & Harman, Bridgeport, Conn. In both welding and soldering, metal parts are joined by depositing molten metal in the gap between the parts and permitting the molten metal to solidify. In welding, however, the edges of the metal parts themselves are melted, whereas, in soldering, the metal parts are never melted. The welded joint is produced simply by fusion. The soldered joint depends for its strength on such factors as adsorption and adhesion.

Silver soldering is no different from soldering with plumbers' or tinsmiths' solder. However, ordinary solder is made of tin and lead, and melts at about 300 degrees F., while silver solder is made of silver and copper, with usually some zinc, and melts at higher temperatures, the range being from 1200 to 1600 degrees F. The advantages of silver solder over other types of solder are strength, resistance to vibration and shock, resistance to corrosion, and ease of fabrication. Practically all metals that can be heated without danger to 1200 degrees F. can be silver-soldered.

The strongest silver-soldered joints are made with the remarkably small gap of 0.0015 inch between the parts to be joined. Being so thin, the joint has a neat appearance. In many cases, the silver-soldered joint is invisible to the naked eye. In a test, it was found that a silver-soldered assembly of 1-inch brass pipe withstood a water pressure of 4300 pounds per square inch without failure. Under direct loading, one of the brass fittings fractured, but the silver-soldered joints remained sound. In addition to its strength at high temperatures, which makes silver solder suitable for joining electrical parts or piping that must withstand temperatures to 850 degrees F., the silver-soldered joint has good corrosion resistance. Silver solder is used especially in chemical equipment in which the joints are exposed to severe corrosion by acids or other reagents.

Recent developments in silver soldering have made it easy to produce excellent joints. A method that is often used for pipes requires only a torch and a ring of silver solder of the same diameter as the pipe. The torch is fed with illuminating gas and air or oxygen. The ring of silver solder is slipped over the pipe to be soldered. The fitting is then slipped over the pipe and the ring. The joint is heated uniformly with the torch until melted silver solder appears at the edge of the joint. Nothing more need be done.

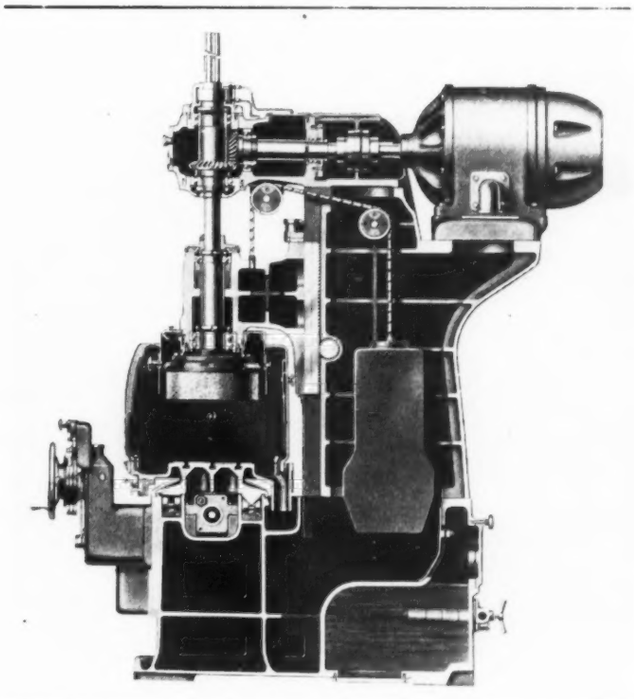
Other developments include dip brazing, in which the joint to be made is dipped in a bath of molten silver solder, and resistance brazing. In the latter method, inserts of silver solder are used, but the heat is supplied electrically rather than by a torch.

Some of the Important Factors in Machine Tool Lubrication

A Review of Some of the Salient Points to be Considered in Selecting the Proper Method of Lubrication for Machine Tools

By A. F. BREWER, Mechanical Engineer
The Texas Co., New York City

THE production of machine shop work of great accuracy and in large volume has been greatly facilitated by the coordination of three factors—correct details of machine tool design, carefully considered methods of lubrication, and operation of the machines by trained men. Builders of machine tools have come to realize that lubrication is one of the most important factors in the successful operation of their machines, with the result that centralized lubrication has been widely incorporated in machine tool design. Hence, we find today the gears, bearings, slides, and guides of lathes, planers, milling machines, etc., lubricated simultaneously by means of bath, splash, or pressure distribution of lubricants.



Cross-section of a Pratt & Whitney Vertical Surface Grinder, Showing the Lubricating Arrangements

The results have been noteworthy—production has increased; the noisy rattle of poorly lubricated gearing has disappeared; and wear has been materially reduced. This reduction in wear, in turn, has made for greater accuracy in the product; the clearances between moving parts are more constantly maintained; and the need for adjustments that would affect the accuracy of the machine has been reduced. Still there are many who appear to look upon the lubrication of gears, bearings, and slides as more or less incidental. It is therefore hardly possible to over-emphasize the fact that effective machine lubrication to reduce frictional resistance is one of the most important factors in obtaining maximum production. It means economical power consumption and reduction in upkeep and maintenance — that is, reduced operating expense. In the last analysis, this means that unit production costs will be the lowest possible.

It hardly seems necessary to dwell on the importance of gear lubrication. The method of lubrication, however, will depend upon the design of the gearing arrangement and the location of the gears with respect to other parts of the machine. Effective gear lubrication requires the maintenance of a sufficient film of lubricant on the wearing surfaces of the teeth. This can be accomplished either by means of fluid oil or by a more inert form of gear lubricant, according to the means available for the application.

Bath or splash lubrication by means of fluid oils is practically automatic. It requires that the gears be contained in an oil-tight casing or housing, so that a certain amount of oil may be constantly kept in the case, the gears dipping in this lubricant to a

sufficient extent to afford the teeth an opportunity to carry or splash the necessary supply of oil to those gears of the train that are located above the oil level. Interior gear-shaft bearings are lubricated simultaneously by the same oil.

Pressure or force-feed lubrication provides for the delivery of oil to the gear teeth in streams of sufficient volume to maintain the required lubricant film. This type of lubrication usually develops a sufficient amount of splash to take care of the bearings within the gear-case also, although on some machines, the oil may be piped directly to them from the oil-pump.

Where splash-, bath-, or pressure-lubricated systems are installed, a medium-bodied machine oil will usually be most suitable. The use of an oil of this type has the added advantage that the same lubricant can generally be employed on many of the other moving parts, such as external bearings, guides, and slides.

Where gears are exposed, however, as in the case of back-gears on engine lathes, or where gear casings are not oil-tight, it is usually necessary to apply the lubricant directly to the teeth. In that case, a heavier or more viscous gear lubricant must be used, as the lubricant film must function for a considerably longer period of time to prevent metal-to-metal contact. The lubricant should stick tenaciously to the teeth and resist the action of centrifugal force, as well as the contaminating effects of foreign matter.

A variety of lubricants are available for this purpose, ranging from semi-fluid greases to the heavy, naphthenic-base straight mineral products so extensively used in the steel industry. Some of these would obviously be too inert and viscous for use on the lighter gears in the average machine tool and would cause increased power consumption. To be sure, they would lubricate, but they would also cause an abnormal amount of drag, which would increase power consumption and possibly reduce speeds. The selection of a lubricant, therefore, must be carefully approached. It should be as light or fluid as possible, commensurate with the tooth pressures involved and the means of application available.

The Effect of the Type of Drive on Lubrication Problems

The type of gearing used in machine tool drives —worm, spur, helical, etc.—has a bearing upon the lubrication problem. In a planer drive, for example, we have a bull gear and a rack which extends the entire length of the under side of the table. In addition, there are other gears that control the cutting and return speeds. Planer gears require careful lubrication, because any undue wear of the teeth or backlash with the attendant pounding or hammering may affect the accuracy of the cut. For this reason, many designers prefer bath lubrication or some form of pressure system that will insure a generous flood of oil over all the gear teeth. In addition to lubricating, this also affords a certain amount of cooling.

Effective lubrication also reduces noise. In proportion to the extent to which the noise of reversing gears is reduced when reversing, one can estimate the degree to which the lubricant is functioning as a shock absorber or silencer. The reduction of these shocks of reversal promotes greater durability of all the wearing parts subjected to shock.

Pointers on Bearing Design

The bearings of machine tools are either sleeve type babbitted bearings, or ball or roller bearings. In addition, there are thrust bearings for the purpose of taking up the end thrust of spindles. Obviously, abnormal friction will develop in bearings if inadequately lubricated. Still, this fact is frequently overlooked. Many mechanics seem to be under the impression that it is of little benefit to pay a great amount of attention to bearing lubrication. This is false economy, because there is too much at stake in keeping machinery in the proper operating condition to overlook the importance of bearing lubrication.

Automatic lubrication of bearings, in some instances, has been an offshoot of gear lubrication. This applies especially to gear-shaft bearings and certain other bearings that are enclosed, so that they can be automatically lubricated by splash or force-feed systems along with the gear teeth. Some manufacturers have carried this one step farther and designed their oiling systems with leads to the more important external bearings and slides.

Centralized force-feed lubrication is decidedly adaptable to lathes, planers, and milling machines. In modern machine tools used to their full capacity, the pressures on certain bearings are relatively high. When the clearances are fairly generous and an oil of sufficiently high viscosity is used, the lubricating film will be thick enough under ordinary conditions to prevent abnormal wear. Too great clearances, however, may defeat the object of obtaining the required accuracy in metal cutting; they are not desirable, therefore, when high-grade work is required. Under such conditions, pressure lubrication is most advantageous. Furthermore, it permits the use of a lighter grade of oil, especially when the pressure on the lubricating system is sufficient to assure complete coverage of the moving parts.

The planning of a centralized lubricating system must be done in accordance with the character of the work, the prevailing pressures, and the type of machinery to be lubricated. On milling machines, the installation of oil reservoirs of sufficient capacity or of independent force-feed lubricators simplifies the problem of design and construction. There are other types of machines, however, for which flood lubrication is regarded as a practical

necessity. These machines are equipped with self-contained oiling systems, the lubricant being pumped to the bearings, gears, and slides by means of a pump, placed either in the oil reservoir itself or at some convenient external point.

The Lubrication of Sliding Surfaces

Slides or guides can be lubricated effectively by automatic means. The motion over sliding surfaces is comparatively slow, but in many cases, the pressure is high, especially on horizontal machines, such as the planer. This leads to excessive wear and increased power consumption unless the surfaces are properly lubricated. Ultimately such wear throws the machine out of line. Hence the lubrication of sliding surfaces must be given careful attention, both when the machine is being built and when it is in operation.

The importance of proper alignment is too well recognized to require discussion. Without proper alignment of the slides on the vees or sliding surfaces, accuracy of cutting is impossible. Pressure lubrication has been adopted by many machine tool builders, and splash lubrication by others, as the means to provide proper lubrication, long wear, and continuous alignment. When pressure lubrication is employed, it is generally designed to serve not only the vees but also the guides, bearings, and adjacent gearing.

With force-feed lubrication, if properly maintained under adequate pressure, the sliding elements virtually float on a film of oil. Wherever V-shaped guides or ways are used, one must consider that a knife-edge contact theoretically prevails. Any imperfections in the contact surfaces, excessive loading, or inadequate lubrication may therefore cause vibration. Positive lubrication will materially obviate this difficulty.

Felt wipers attached to the sliding elements, with means for saturating with oil at frequent intervals, have proved suitable on some machines. Wipers are advantageous because they serve to keep the V-grooves clear of dirt and thereby reduce the possibility of scoring of the wearing surfaces. Still another method of V-lubrication frequently met with makes use of a number of wheels or disks, which are free to revolve in depressions or reservoirs located in the V-grooves, their surfaces being held in close, but not rigid, contact with the V-shaped projections on the sliding elements. As the latter slide over these rollers, they rotate and carry a film of oil to the projections from the reservoirs below, thereby functioning in much the same manner as a ring oiler on a rotating shaft. As long as the oil in the reservoir is kept at such a level as to insure constant dipping of the lower parts of the rollers, lubrication will be positive and automatic.

The mechanical force-feed lubricator, however, should be regarded as an accessory. Lubricating devices of this type are entirely self-contained. They can be attached to an existing machine with practically no alteration in the arrangement of the operating mechanism. All that is necessary is to install oil piping from the pumps to the parts to be lubricated. Pressure lubrication by means of mechanical force-feed lubricators is advantageous in that the flow of oil to each part can be accurately controlled, so that as nearly as possible the right amount of oil can be supplied. In this, the mechanical lubricator is comparable with the sight-feed oil-cup which is readily adapted to external parts, such as guides and slides. Both lend themselves to installation at a convenient level to facilitate refilling and adjustment.

The Selection of Lubricants

The use of oil as a lubricant in connection with pressure, splash, or individual oil-cup lubrication normally permits the use of one grade to serve all the wearing parts, provided they are properly designed and suitably enclosed to prevent abnormal leakage. In such cases, a machine oil having a viscosity range comparable to a medium automobile engine oil will normally be suitable. The machine oil, however, does not have to be as highly refined as would be required for automotive service; hence the cost should be lower. Carbon residue content and low pour test need not, as a rule, be considered; the main objective should be to study the viscosity range at operating temperatures to insure an adequate film at all times, regardless of load conditions.

Grease is adaptable for the lubrication of many machine tool parts. Grease lubrication is generally applied only to the individual servicing of bearings. The compression grease cup, the pin type lubricator, or the pressure grease-gun fitting constitutes the usual equipment. More recently, however, a multiple-fitting lubricator has been developed to make the application of grease to each lubricated part more automatic. Grease lubrication is advantageous wherever the bearing design or construction would allow fluid oils to drain out from the clearance spaces too quickly, thereby causing waste or objectionable conditions around the machine.

Greases must always be selected with care. They are compounds of relatively fluid oils and certain soaps, and hence their lubricating efficiency is only as great as that of the oils used in their manufacture. The soap serves only as a carrier to hold the oil in suspension. As a result, the base and apparent lubricating quality of the mineral oil content of a grease should be investigated. Greases should remain in as nearly as possible a state of perfect mixture, with the minimum tendency toward oil separation; otherwise, the lubricating efficiency will be reduced, oil leakage will occur, and soap accumulation in the bearing oil-grooves may result.

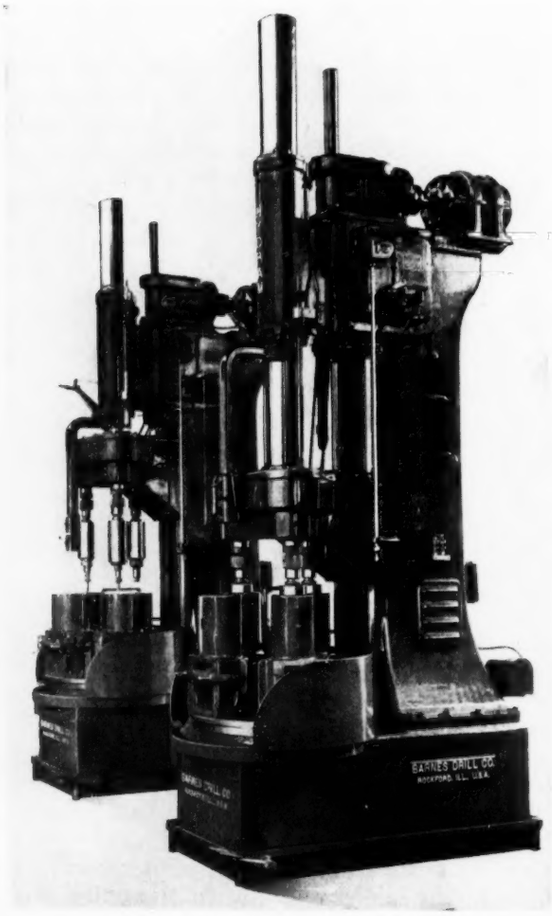
Greases must also be chosen with respect to the equipment by which they are to be applied. When

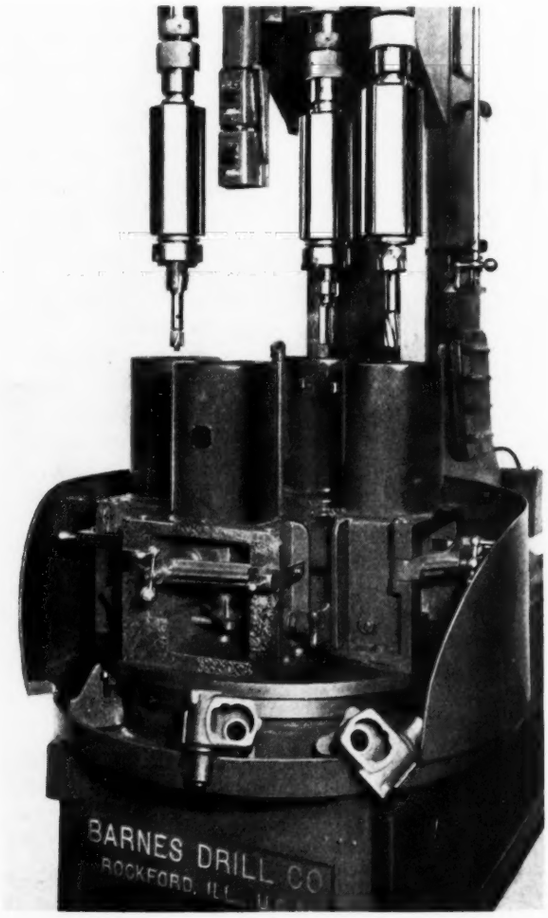
automatic pressure or heat reaction upon a grease is relied upon for its delivery to the bearings, a somewhat lighter product can be used than when a compression cup is employed. On the other hand, the penetration or consistency of any grease must be studied with regard to the amount of pressure available. High pressures enable heavier greases to be used. They should never be too hard, however; otherwise, the drag due to internal friction may cause an increase in power consumption, with a decrease in productive efficiency. Likewise, the use of too heavy a grease may preclude complete penetration through small clearance spaces in some types of sleeve bearings or may lead to channeling in ball or roller bearings.

Summer Conference on the Teaching of Mechanical Engineering

The Mechanical Engineering Division of the Society for the Promotion of Engineering Education will hold a conference on June 28 and 29 in Cambridge, Mass., to consider various phases of the teaching of mechanical engineering. This conference will precede the annual meeting of the Society, which will be held from June 29 to July 2 at the Massachusetts Institute of Technology and Harvard University. Further details of the conference can be obtained from Professor Frank L. Eidmann, Columbia University, New York City, who is chairman of the conference.

Two Machines that Typify Progressive Production in Machining Steering Gear Housings are Shown in the Illustration Below. One Machine Successively Performs Roughboring, Combined Counterboring and Facing, and Reaming Operations on One Side of the Casting. The Other Performs Similar Operations on the Opposite Side. These Machines were Built by the Barnes Drill Co., Rockford, Ill. A Distinctive Feature of Both of These Hydram Machines is the Provision of Pilots 3 3/4 Inches in Diameter by 8 Inches in Length which are Located Directly above the Tools. The Tool-spindles Revolve in Ball Bearings Inside of These Pilots, and the Pilots are Guided in Bushings Mounted in the Work Fixtures





Machine for Lapping Worm Threads on Twenty Shafts Simultaneously

By BEN CLARK

The worm-drive shafts used in odometers are surface-hardened in order to give them the desired wear resistance. After being hardened, the shafts are straightened, the outside diameter ground with the shaft held on centers, and the worm lapped to a very smooth finish. The problem of lapping the threads was solved by building the machine shown in the accompanying illustrations.

Fig. 1 shows the adjustable reciprocating mechanism of the lapping machine, which is so designed that it will operate twenty work-holding spindles at one time. These spindles are so arranged that the work can be loaded or removed from any spindle without interfering with the work in the others. The locations of only four of the twenty spindles are shown in Fig. 1. The complete unit, however, is driven by the large pulley *P*, and may be mounted on legs or on a bench. A typical cross-section through the center of one of the work-holding spindles is shown in Fig. 2. The worm to be lapped is shown at *A* in contact with a lap *B*.

The laps are cast of lead in a special half-mold. They are held in the end of the clamp by the dove-

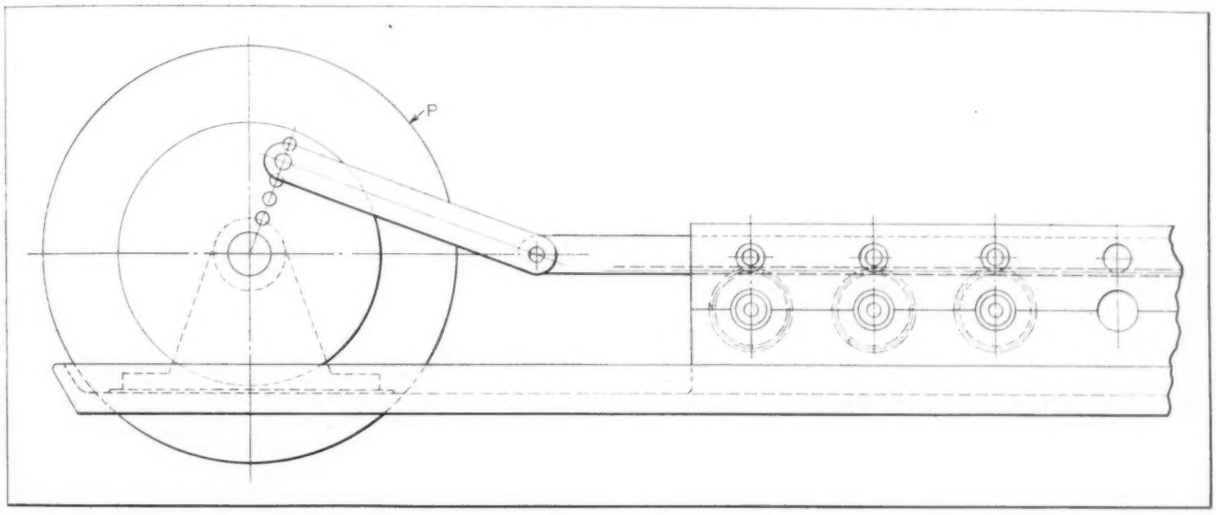


Fig. 1. Mechanism for Imparting Reversing Rotary Movement to Worm Thread Laps

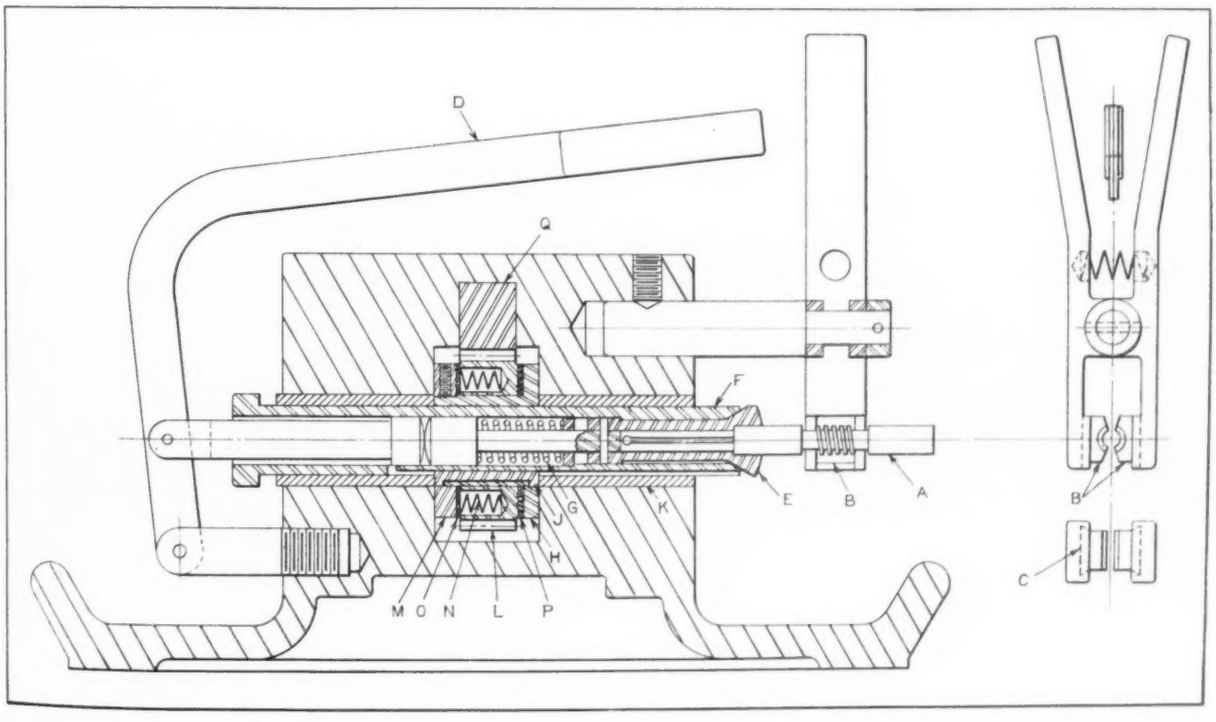


Fig. 2. Cross-section through One of Twenty Lapping Spindles Driven by Mechanism Shown in Fig. 1

tail joint shown at *C*. To load or remove work, lever *D* is depressed, which opens the chuck *E*, and the clamping handles of the lap are squeezed together to release the work. Chuck *E* is carried in the end of gear-spindle *F* and is closed by the spring *G* when lever *D* is released.

The worm thread running in the lap causes spindle *F* to slide through the clutch sleeve *H* on keys *J*. The two keys *J* are located opposite each other. Spindle *F* turns and slides in a bushing *K* in the body of the machine. The drive gear *L* is mounted on clutch sleeve *H*, and is held in place by the collar *M*, which is secured by two or more set-screws. Springs *N*, fiber pads *O*, and fiber washer *P* complete the friction clutch. The friction clutch is required to permit the work to be loaded in any spindle at any part of the working stroke and with the work-spindle *F* in any position.

When the shoulder of the worm-shaft comes in contact with the side of the lap, the friction clutch slips until the return motion begins. The stroke of the driving rack *Q* is adjustable to suit the travel of the worm thread, so that slippage occurs only when work is loaded out of synchronism or something causes the spindle to jam.

A paste of fine abrasive powder and oil is used to charge the laps. When some of the worms need more lapping than others, the procedure is to complete the loading of the twenty spindles and then start unloading and reloading. The worms are washed and inspected when removed from the lapping machine. From 1 to 4 per cent of the worms were returned to be relapped when the lapping machine was first put in operation. Corrections in the thread-milling and straightening operations, however, have made it practically unnecessary to return any work for relapping.

* * *

Destructive Taxation

Not long ago the newspapers of the country told about the razing of a 22-story skyscraper in the Loop district of Chicago, because under existing conditions, its owners decided that they could not afford to pay taxes on it any longer. A couple of years ago, several fine buildings on Cortlandt St., New York City, were torn down and "taxpayers" erected on the site, the object being to reduce tax-carrying charges. Hundreds, if not thousands, of structures in the metropolis and in cities and towns throughout the metropolitan district have been torn down and the ground leveled off for parking space for the same reason — that our system of realty taxation makes the maintenance of buildings too expensive a luxury.

How towns and cities expect to grow, prosper, or get ahead—how labor is to be re-employed and become a national asset instead of a liability—under a system of taxation which discourages the erection of buildings and encourages their razing, is beyond comprehension.—*Commerce and Finance*

Using Models for Setting up Machines and Checking Work

By HECTOR J. CHAMBERLAND

Having noted the surprisingly low percentage of spoiled work in a plant building high-priced automobiles in small lots totaling not over fifty per month, the writer wonders why the "go by the model" system used in this plant is not employed more frequently as a means of reducing the scrap pile. The system is, of course, suited only for plants having a comparatively small output, where the same machine is used for several operations and frequent set-ups are necessary. Obviously, the system is not adapted for use in mass production plants, where a machine tool is permanently set up for a certain operation.

In the case referred to, models or master parts were provided for each operation, including those performed on the automatic screw machines, as well as grinding operations on no less than 1000 parts. All parts were manufactured in lots of 100, 200, 300, etc., depending upon the number of pieces required for each unit. On starting a new job, the operator obtained the necessary drawing by presenting the routing card at a specified window of the tool-crib. The next step was to obtain the tools for the set-up. A master part on which the operation to be performed had been completed was also given out with the tools. After machining the first part to exactly duplicate the model, both the work and the model were taken to the inspector for an O.K. before proceeding.

This system did not eliminate the use of gages, but the management, as well as the workmen, knew that it prevented many costly errors in setting up for a new operation. It avoided errors resulting from incorrect reading of a drawing; using the wrong gage or one that was worn or out of adjustment; and incorrect settings or readings of micrometers, verniers, or other measuring instruments. It is safe to assume that with a drawing, a properly adjusted measuring instrument, and a model to go by, as provided by this system, there is little chance for errors, as all three of these factors can hardly be wrong at the same time.

* * *

Ordinarily one does not think of glycerine as having important functions in machine shop operations. Walter S. Tower, executive secretary of the American Iron & Steel Institute, points out the following uses for glycerine in shop practice: (1) As the fluid medium in pressure gages; (2) as an antifreeze compound in pumps; (3) as a valve packing in pumps and gages when mixed with white lead; (4) as a low-temperature lubricant when mixed with graphite; (5) for the transmission of pressure in some testing machines; (6) for the absorption of energy of recoil in certain types of presses.

Zinc-Alloy Die-Castings for Oil Burners

While die-castings have long been employed to advantage in almost all kinds of home appliances, they have not been used until recently in oil burners. The general use of cast iron in the construction of furnaces and furnace accessories doubtless has retarded the application of die-castings in the oil burner field.

Recently, however, the Bethlehem Foundry & Machine Co., which has ample facilities for both producing and machining sand castings, has given consideration to die-castings for certain oil burner parts. While the major parts of the burner that the company manufactures are made from cast iron, like the frame and the barrel adjacent to the flame end, where temperatures too high for die-castings are encountered, many other parts are die-cast from zinc alloys. The largest of these is a cradle, to one end of which is fastened the motor that drives the blower. By making this part from a die-casting, it can be used without machining and yet permits of perfect interchangeability.

As will be seen from the illustration, this die-casting (shown at the top) has a series of slots in it, forming a sort of squirrel cage. Surrounding this is a second die-casting of similar shape. Neither of these castings needs machining, yet one fits closely into the other. Other die-castings used in the burner are shown in the lower part of the illustration. One important advantage of the use of die-castings is that they remain free from rust, even when installed in a damp cellar.

The tensile strength of these zinc-alloy die-castings ranges from 35,000 to 55,000 pounds per square inch. Their impact strength is high, from 15 to 20 foot-pounds being required to break a standard die-cast test bar of 1/4-inch square section. This is estimated to be from seven to ten times greater than the corresponding impact strength of ordinary gray cast iron.

The outer case of the burner could doubtless also be made from a zinc casting, but in this case it is made from a molded plastic. Because of the non-resonant properties of plastics, this is conducive to quiet operation. Similar results can be obtained with die-castings by proper ribbing and by adding a soft gasket or applying asphaltic "dope," such as is used on metal panels of automobile bodies; but the cost of this might be higher.

* * *

When we're right we credit our judgment; when we're wrong we curse our luck.—*United Effort*

Making Circular Forming Tools

By H. J. WILLIAMS, Tool-room Foreman
U. S. Slicing Machine Co., La Porte, Ind.

On page 330 of January MACHINERY is published an article "Making Circular Forming Tools without Mathematical Calculations." The method described is partly in error. A grinding wheel that has been formed correctly on the center cannot be set a certain distance below the center and then be expected to reproduce the correct form on a circular tool. Setting the wheel below the center does not change the point of contact in relation to the tool to be formed, since the contact point between the wheel and tool will always be on a line drawn through the centers of both, and the correct form will be reproduced only at this point of contact. The method would apply, however, if a flat formed master tool were used.

* * *

A machine for bending 1 4-inch square steel bars into an arc of 3-inch radius is equipped with a dog and ratchet which disengage during each bending operation. The ratchet teeth were torn so badly by the action of the dog that the ratchet became useless within one month's time. A wear-resistant alloy was applied to the ratchet teeth for protection, and on inspection after eighteen months' service, the ratchet was found to be still in such good condition that it was put back into the machine.

Bethlehem Doe Oil Burner and Die-castings Used in Its Construction for Purposes of Economy and Strength

Production of Machine Tools in 1935 and 1933

Class	1935		1933	
	Number	Value	Number	Value
Machine tools, total value		**$85,068,851**		**$23,936,232**(1)
Made in the industry		83,077,076		23,266,205
Made as secondary products in other industries		1,991,775		670,027(1)
Replacement and repair parts		11,570,873		5,694,269
Bending machines	629	581,755	343	226,358
Boring machines:				
Horizontal	321	1,592,222	98	440,164
Vertical				
Number reported	24	306,607	20	78,563
Number not reported	...	33,670	...	.....
Special types				
Boring, drilling, and milling combined	80	1,178,337		
Boring and turning combined	36	321,469	(2)	374,215
Other, including jig borers	94	719,996		
Broaching machines (other than keyseaters):				
Number reported	219	668,210	(2)	(2)
Number not reported	...	156,886		
Cutting-off machines (see end of table)				
Drilling machines:				
Horizontal				
Number reported	140	704,159	(2)	304,017
Number not reported	...	269,927	...	.....
Vertical				
Multiple-spindle other than sensitive				
Number reported	360	1,143,979	45	154,137
Number not reported	...	64,333	...	.....
Standard	661	398,642	233	105,132
Sensitive (including bench type)				
Single spindle				
Number reported	8398	450,295	218(3)	37,018(3)
Number not reported	....	205,092	...	.....
Multiple-spindle	428	613,466	56	62,268
Radial				
Number reported	250	774,272	(2)	304,106
Number not reported	...	324,426	...	.....
Combined vertical and horizontal	42	252,966		
Drilling and tapping	...	752,036		
Other special			(2)	669,237
Number reported	173	539,392		
Number not reported	...	360,104		
Forging machines:				
Drop hammers and presses (impression-die)	71	494,290		
Forging hammers (flat-die)				
Number reported	18	41,147	(2)	477,104
Number not reported	...	11,422		
Other, including bulldozers and upsetters	...	1,517,694		
Gear-cutting machines	896	4,612,029	(2)	1,029,765
Grinding machines:				
External-cylindrical	618	3,185,921	319	1,045,153
Universal	208	646,973		
Surface	1110	1,931,889	167	329,743
Cutter and tool	575	712,928	172	203,606
Internal-cylindrical	503	2,588,024		
Drill	302	101,564	(2)	2,048,158
Snagging or tool grinders (hand), wet or dry	1188	73,556		
Other, including disk	....	3,449,083		
Honing machines:				
Number reported	118	383,129	55	125,320
Number not reported	...	30,360	...	.....
Lathes:				
Bench (plain and screw-cutting)	12,072	1,125,477		
Engine				
General-utility				
Capacity 16" swing and under	1935	2,249,289	3283	1,424,973
Capacity over 16" swing and including 22"	504	1,058,129		
Capacity over 22" swing and including 36"	96	490,311		
Heavy-duty over 36" swing	14	157,869		
Gap	18	32,923		
Automatic single-spindle				
Bar and chucking				
Number reported	823	2,298,028		
Number not reported	...	959,174		
Automatic multiple-spindle				
Bar				
Number reported	511	2,971,756	242	1,185,203
Number not reported	...	632,103		
Chucking				
Number reported	294	2,548,015		
Number not reported	...	576,818		

Class	1935		1933	
	Number	Value	Number	Value
Turret				
Horizontal hand-operated				
Ram type	633	1,491,427		
Saddle type, standard and heavy-duty				
Number reported	290	1,699,923	201	516,372
Number not reported	...	413,789		
All other lathes, including vertical-turret, polishing, etc.	(2)	1,169,774	(2)	851,386
Milling machines:				
Plain	410	990,427	135	359,515
Universal	582	1,608,090	120	294,569
Vertical	406	1,410,536	69	191,294
Planer type	81	675,325		
Other, including automatic and Lincoln type			(2)	495,893
Number reported	651	2,241,181		
Number not reported	...	30,124		
Planers (see end of table)				
Portable tools:				
Drills, electric				
Number reported	68,388	2,380,524	19,091	775,357
Number not reported	....	.....	.....	94,169
Pneumatic				
Number reported	7449	1,035,621	5024	633,488
Number not reported	....	1,457,340	.....	.....
Grinders, electric				
Number reported	20,764	917,075	5968	200,541
Number not reported	...	.....	...	60,025
Pneumatic	4533	486,264	2344	205,698
Hammers (chipping, riveting, calking, etc.), electric	965	115,932	428	60,821
Pneumatic				
Number reported	11,833	714,173	10,824	568,456
Number not reported	....	156,359	.....	.....
Other (including motor-driven garage equipment)				
Number reported	14,737	790,748		
Number not reported	....	3,624,882		
Flexible-shaft			(2)	2,302,836
Number reported	2563	289,760		
Number not reported	....	188,100		
Presses (except forging presses)				
Forming and stamping				
Number reported	1635	3,912,867	755	1,105,799
Number not reported	....	556,953	...	325,767
Punch, number reported	376	515,417	(2)	99,971
Number not reported	...	112,776	...	.....
Other	...	931,231	(2)	164,060
Punching machines (see end of table)				
Riveting machines (not portable):				
Number reported	486	128,012	...	55,185
Number not reported	...	67,429		
Shapers:				
Vertical and slotters	76	208,733		
Horizontal				
20" stroke and under	247	401,033	35	58,458
Over 20" stroke and including 28"	81	179,987		
Over 28" stroke	58	130,918		
Shears:				
Alligator, rotary, and combination punch and shear	175	189,450	105	124,022
Straight	482	549,253		
Other, including hand-lever and foot-power (see below)				
Threading machines:				
Other than pipe-threading				
Die and rolling types	316	426,984		
Milling type	36	188,812		
Tapping machines			134	132,293
Number reported	313	321,996		
Number not reported	...	251,563		
Pipe cutting and threading machines				
Single-head	718	656,525	359 (4)	198,934
Multiple-head (number not reported)	...	139,877		
Cutting-off machines:				
Band saw	75	52,453		
Hacksaw	879	344,754		
Other, including cold-saw	43	128,264		
Planers:				
Standard, over 36"	16	251,439		
Open-side	25	172,989		
Other, including standard 36" and under	101	128,570	....	3,437,083
Punching machines (not portable)	...	61,701		
Shears, other than those specified above, including hand-lever and foot-power:				
Number reported	522	39,398		
Number not reported	...	5,708		
All other machine tools	...	2,834,243		

[1]Revised. [2]No comparable data. [3]Not strictly comparable with corresponding figure for 1935 because of changes in the form of the questionnaire used in canvassing this industry. [4]Estimated in small part.

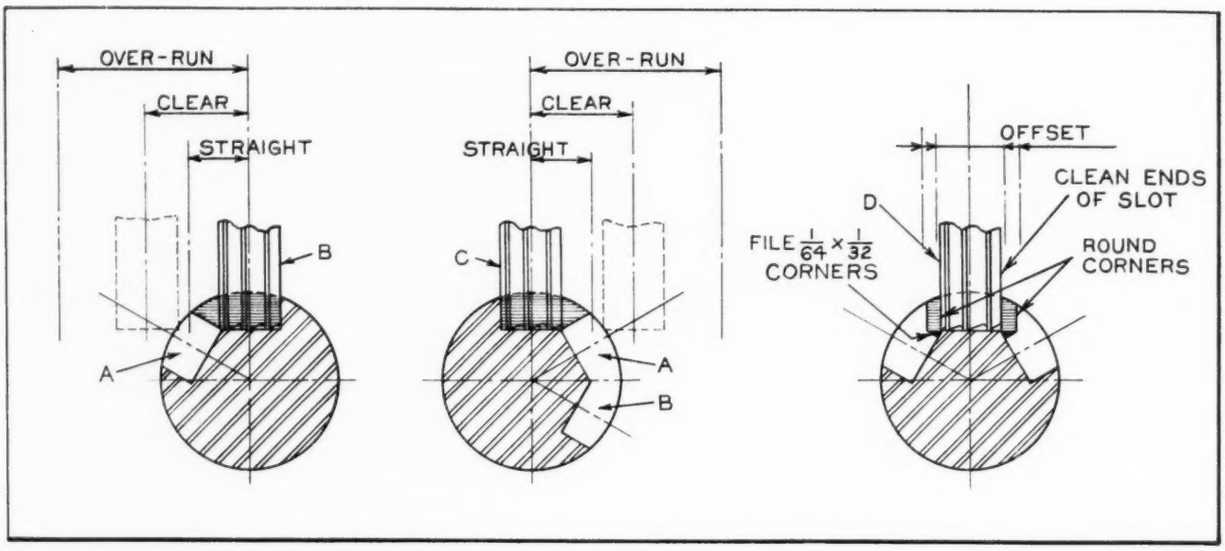


Fig. 1. Cross-sections Showing Successive Steps in Milling Slots B and C, Fig. 3

An Unusual Profile-Milling Operation

By F. SCRIBER

IN the manufacture of airplane accessories, an unusual profile-milling operation is performed on a small slide-rod. The rod is 5/8 inch in diameter by 15 inches long. The cross-section views of the rod in Fig. 1 indicate the cuts taken in the first, second and third or final set-ups. The first operation consists of milling the slot *A*, Fig. 3, on a horizontal milling machine, using a circular cutter. The locking slots *B* and *C* shown in this illustration are produced by roughing and finishing cuts taken by end milling in a profiling machine.

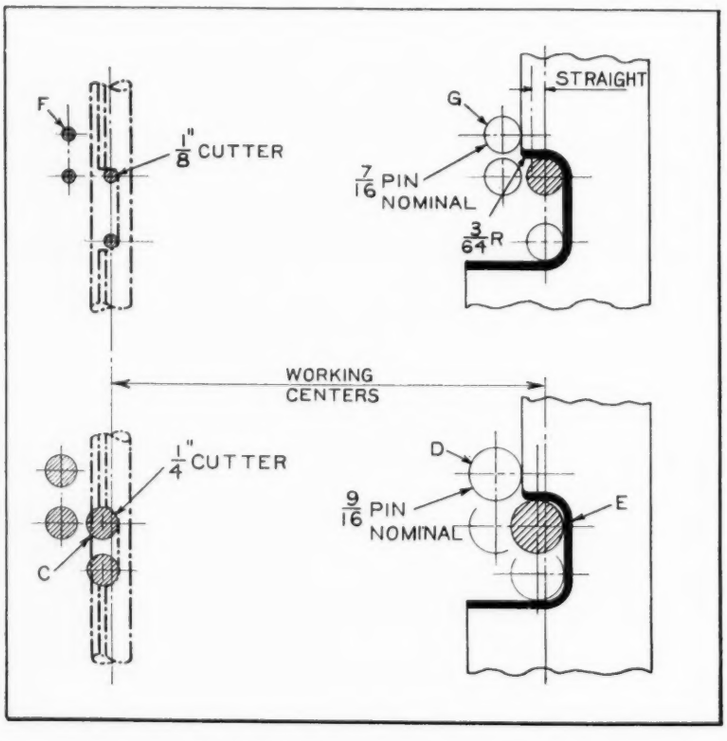


Fig. 2. Method of Machining Slots on Profile Miller

The rod is held in a simple fixture comprised of V-blocks and a locating stop for the profiling. The radial location for each set-up is taken from the long slot *A*. Referring to Fig. 2, the first profile-milling set-up provides for recessing the right-hand side of the slot with the end-mill *B*, indicated in the view to the left, Fig. 1. The cutter *B* is set vertically in the machine spindle that traverses across the work in milling the straight portion of the slot. In addition, the cutter must be fed a substantial distance to clear the work, after which it is allowed to over-run so that it will clear the clamping devices on the fixture.

In milling the profile, the cutter shown at *C* in the lower view, Fig. 2, traverses the required path guided by pin *D* in the frame of the spindle-carrier, the particular machine used being equipped with two spindles so that one can be used for roughing and the other for finishing. For rough-milling, a cutter 1/4 inch in diameter is used

and a relatively large guide pin is employed in the formed slot *E*. This leaves the slot corners larger than required, but enables the operator to take a heavier cut than is possible when using the smaller cutter required for finish-milling. The latter operation is indicated in the upper view, Fig. 2, in which the cutter *F*, guided by the pin *G*, takes the finish-milling cut. Four positions of the cutter and guide pin are shown in both the roughing and finishing diagrams.

The arrangement of the work and cutters for profile-milling the recess at the opposite side of the slot is shown in the central view, Fig. 1, the guide and guide pin arrangement being similar to that shown in Fig. 2, except that the set-up is arranged to take the profiling cut on the opposite side of the slot. This set-up is also arranged for roughing and finishing cuts.

After milling the recesses, as described, their corners are rounded and the bottom of the long slot is end-milled to remove the stock left by the circular slotting cutter. This operation is indicated in Fig. 3 and in the view to the right, Fig. 1. The view to the right, Fig. 1, shows the cutter *D* rounding the shaded corners to the right and left of the center slot. The formed block *E*, Fig. 3, is used with a guide pin *F* for profiling. The pin *F* is approximately the same size as the cutter *G* which is shown in five positions in the upper slot and in six positions in the lower slot. There is a very small amount of metal to be filed out of each corner, as shown by the view to the right, Fig. 1. However, the procedure described proved to be an entirely satisfactory way of handling this profile-milling job.

* * *

Effect of Surplus Tax on Factory Employment

An informative booklet entitled "The Coming Effect of the Surplus Tax on Factory Employment" has been published by Allen W. Rucker in collaboration with N. W. Pickering, president of the Farrel-Birmingham Co., Inc., Ansonia, Conn. The obvious fact that job security in the long run depends upon the ability of corporations to earn and retain a reasonable return on their investment is emphasized. The authors contend that job security for labor, as well as purchasing power, will be impaired by the enforced distribution of corporate earnings under the 1936 Revenue Act.

The analysis made by the authors shows that factory unemployment since 1923 has been most serious in industries and states where corporation profit probabilities are the lowest or where they are declining the fastest. In Massachusetts, New York, Rhode Island, Connecticut, Pennsylvania and New Jersey there has been a decline in factory employment since 1923. This shrinkage in employment has been coincident with the shrinkage of the percentage in corporations able to earn and retain a profit in those states.

The authors advocate an amendment to the tax laws exempting from the surplus tax that portion of corporate earnings which has been invested during the year in productive equipment, and also that part which has been applied to capital losses incurred during, say, two or three years immediately preceding. They also advocate a revision of the tax laws to provide for the computation of losses on the basis of sound accounting principles, instead the present method required by the law, of arbitrarily disallowing certain expenses and losses and thereby forcing the payment of an income tax when in reality there has been no actual income.

* * *

Credit Practice in Machine Industries

A series of meetings of the credit men of the machinery industries has been scheduled to be held during the forthcoming Seventh Credit Congress of Industry at the Hotel Stevens, Chicago, Ill., June 21 to 25. This Congress is held in conjunction with the forty-seventh annual convention of the National Association of Credit Men. The machinery group of credit executives is headed by H. E. Kay, credit manager, Industrial Brownhoist Corporation, Bay City, Mich.

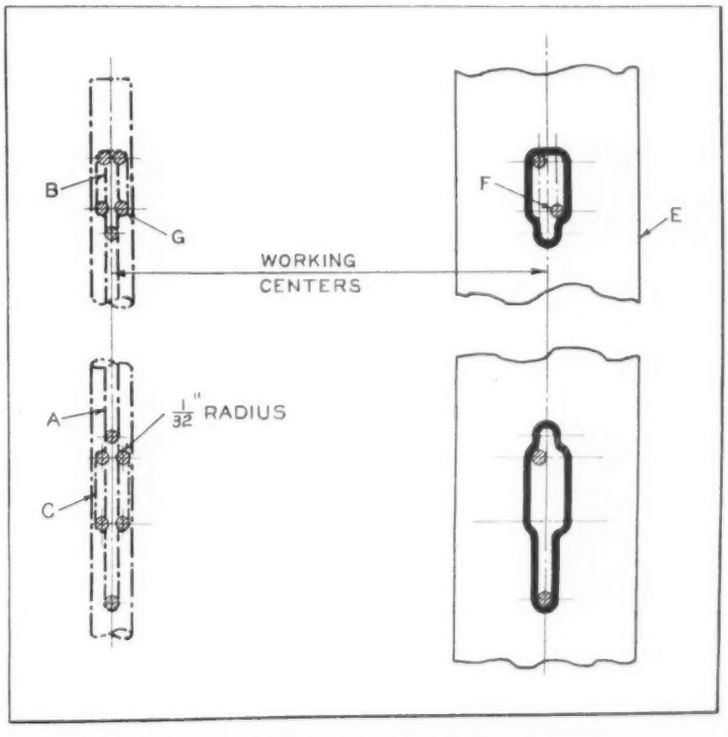


Fig. 3. Set-up for Finishing Slot Ends and Recesses

Photographic Index for Locating Patterns

By A. HENDERSON
J. H. McEvoy & Co.
Houston, Texas

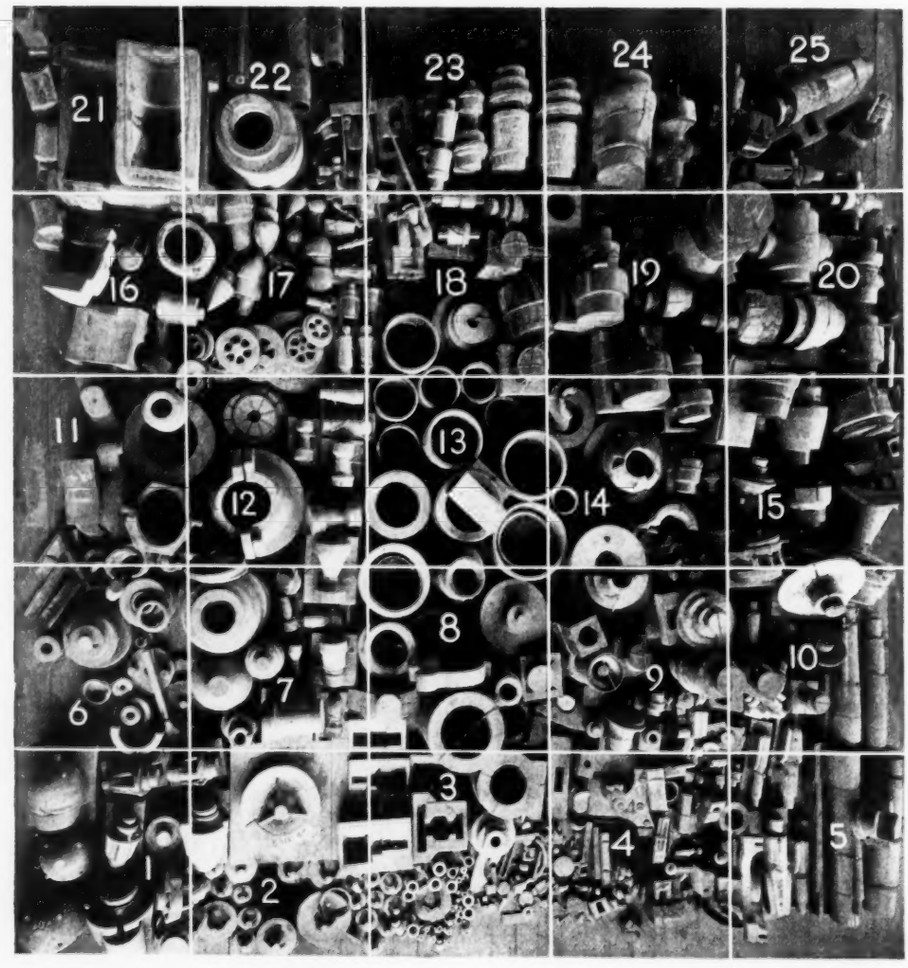
SIMPLICITY is the secret of success in the application of many indexing and recording systems. A glance at the accompanying illustration and the following explanation of its use will make clear the operation of a photographic indexing system that probably meets its particular requirements in the simplest manner possible. The idea on which this system is based has many possibilities and may be employed for many purposes other than that of indexing obsolete patterns, for which it was originated by J. H. McEvoy & Co., Houston, Texas.

The system here described was developed some time ago when the company was confronted with the necessity of doing something about its obsolete patterns, of which a large number had accumulated. Such a condition is usual in a small shop that caters to an industry where changes are as rapid as they are in the producing part of the oil industry. It was thought that if we could remember what the patterns looked like, there might be times when the making of a new pattern could be avoided by remodeling an old one. We found, however, that there were too many patterns to do this, and the expense of indexing them was not justified.

The problem was solved by placing the patterns and core-boxes on the floor and photographing them from as nearly a vertical position as possible. The picture was then laid off in twenty-five squares, as shown, the numbers of which corresponded to numbers on bins in which the patterns were placed. The patterns were placed in the bins indiscriminately, except that patterns in any one square in the picture were put in the bin having the same number as the square.

To find a pattern, the photograph is inspected until one or two patterns that look as though they might meet requirements are found. Then the bins with the proper numbers are searched until the desired patterns are found. To compensate for distortion in the picture, some patterns were marked to show their size. For instance, in square No. 11 will be seen a piece marked 11 1/2, which is the length in inches of the piece. In square 13 is seen a piece marked 12 inches, and in square 20 is a piece marked 10 inches, and so on. Patterns are grouped in classes when possible.

This system has made it possible for old patterns to be used at various times; and in some cases, patterns that had been set aside, but have become active again, have been located and put back in service.



Photograph Divided into Square Sections to Show Patterns Stored in Bins that are Numbered to Correspond with Squares

First Aid to Water-Logged Electric Tools

The following suggestions are made to electric tool users by John S. Hand, service manager of the Black & Decker Mfg. Co., Towson, Md.

Submersion in water usually ruins the insulation in the tools, as well as the fiber parts. The grease becomes diluted and dirty, and when submerged in water during flood conditions, all parts become covered with silt or mud. The following rules should be observed in cases of this kind:

Do not operate electric tools, motors, or switch mechanisms until they have been taken apart cleaned, and baked out. If possible, send the tools to a factory service branch to be overhauled by experienced men.

If it is necessary to do the work in the plant where the tools are used, the following procedure is suggested:

Completely disassemble the tool.

Put the armature and field in an electric oven and bake them for twenty-four hours at a temperature of 275 degrees F.

Check armature and field for shorts and grounds. If they prove satisfactory, apply a coat of insulating compound and bake again for twelve hours at 275 degrees F.

All fiber switch and brush riggings should be replaced. Most switches will have to be replaced. All taped wire connections should be cleaned and retaped.

Clean all ventilating holes in the tools.

Wash all grease from gears, housings, and bearings; repack with new lubricant, using a good grade of medium cup grease.

Clean rust and dirt from all parts.

These instructions apply to electric grinders, both portable and bench; sanders; polishers; drills; screwdrivers; hammers; heat guns; saws; valve refacers; and most types of motor-driven electric tools.

* * *

Welding Society to Award Lincoln Gold Medal

The American Welding Society announces the acceptance by the board of directors of a gold medal which will be known as the Lincoln gold medal, to be presented to the author of the best paper on any phase of welding published in the Journal of the American Welding Society during the year October, 1936, to October, 1937. The medal will be presented during the annual convention in October, this year. The award has been offered by J. F. Lincoln, president of the Lincoln Electric Co., Cleveland, Ohio. Papers to be considered must be received by the Journal of the American Welding Society before September 15, 1937. For further information, address the American Welding Society, 33 W. 39th St., New York City.

Prizes Aggregating $200,000 Offered in Welding Field

The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, has announced a competition offering the highest awards ever distributed in the mechanical industry. To stimulate intensive study of arc welding, $200,000 will be distributed by the Foundation in 446 separate prizes for papers dealing with the application of arc welding as a primary process of manufacture, fabrication, or construction in eleven major divisions of industry.

The principal prize winner will receive not less than $13,700; the other prizes range from $7500 down to $100. The latter sum will be awarded to each of 178 contestants whose papers are judged worthy of honorable mention, but who receive no other prize.

In order to assure equal competitive opportunity, similar prizes are offered in eleven major divisions of industry: Automotive, aircraft, railroad, watercraft, structural, furniture and fixtures, commercial welding, containers, welderies, functional machinery, and industrial machinery.

To participate in this contest, it is necessary that submitted papers either describe the redesign of an existing machine, structure, building, etc., so that arc welding may be applied to its manufacture; or that they present a design either in whole or in part of a machine, structure, building, etc., not previously made—the description to show how a useful result that was impractical with other methods of construction or that can be done better by arc welding is obtained. In certain classifications, however, slightly different requirements obtain. In the divisions of commercial welding and welderies, for example, the competing papers may describe how to conduct such a business successfully.

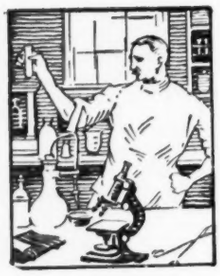
Papers in duplicate must be submitted not later than June 1, 1938. Complete details and rules concerning the contest can be obtained by communicating with the Foundation secretary, A. F. Davis, P. O. Box 5728, Cleveland, Ohio.

* * *

Second Machine Tool Electrification Forum

The Westinghouse Electric & Mfg. Co. will sponsor a second Machine Tool Electrification Forum at its East Pittsburgh works April 19 to 22. The subject to be discussed will be "New Methods and Designs for Machine Tool Electrification." Papers on difficult problems will be presented by representatives of machine tool builders, and talks will be given by application and design engineers of the Westinghouse organization. Inspection trips through the East Pittsburgh and Nuttall works will also be included in the program. At the first Machine Tool Electrification Forum, held last June, there was a total attendance of over sixty machine tool engineers and designers.

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

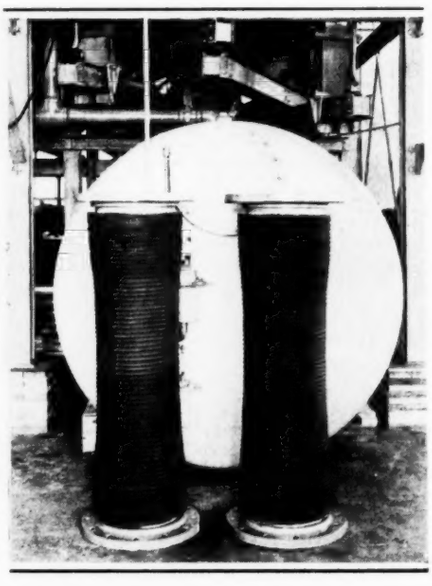
Aluminum Permanently Colored by a New Process

According to *Industrial Britain*, a new firm, Anotints, Ltd., has been established in Birmingham, England, for working a process by means of which aluminum can be colored in beautiful permanent colors. Processes for coloring aluminum are not new, but the present method is said to be a new development. The process makes use of electrical current. A protective covering is provided which becomes an integral part of the aluminum and is not in the form of a deposit, as in plating. It is also stated that aluminum treated by this process becomes insulated against electrical currents up to 500 volts and that the coating is noncorrosive, permanent, and fade-proof.

Thiokol Synthetic Rubber Parts in Largest Liquid Weighing Scale

Gasoline and oil are weighed at the rate of 27,500 pounds a minute in the world's largest automatic liquid weighing scale, which was recently delivered to the Cuban Government. This scale is being used for the quick weighing of cargoes of gasoline and oil in order to levy the import duties accurately. Satisfactory operation of the scale over a period of time will depend largely upon the ability of the rubber parts to retain their flexibility and resistance to the liquids handled, the scale being guaranteed to be accurate within one-tenth of 1 per cent.

The scale manufacturer selected Thiokol synthetic rubber for the various rubber parts. Among the parts made from this material are the seat disks of large valves and lengths of 12-inch hose, two pieces of which are shown in the accompanying illustration.



Two Lengths of 12-inch Flexible Thiokol Synthetic Rubber Hose Used in the World's Largest Automatic Liquid Weighing Scale

Bronzes with Unusual Combination of Ductility, Hardness, and Strength

Four grades of bronze that are claimed to possess an unusual combination of ductility, hardness, and strength have been made available for both castings and forgings by the Bartlett-Hayward Division of the Koppers Co., Baltimore, Md. From the accompanying table of physical properties it will be seen that the tensile strength ranges from 90,000 to 120,000 pounds per square inch, and the hardness from 185 to 250 Brinell.

These D-H-S bronzes, as they are called, are ductile in spite of the fact that their compressive strength is especially high. They are particularly satisfactory for withstanding shocks, heavy loads, and the wear that ordinarily occurs in heavy-duty applications. They also resist certain acid solutions. The manufacturer recommends these bronzes for a large variety of parts, including spur,

Physical Properties of D-H-S Bronzes

Grade	No. 1	No. 2	No. 3	No. 4
Ultimate Tensile Strength, pounds per square inch	120,000	115,000	105,000	90,000
Yield Point, pounds per square inch	95,000	90,000	60,000	45,000
Elastic Limit, pounds per square inch	60,000	55,000	50,000	40,000
Elongation, per cent in 2 inches	10	12	17	25
Reduction of Area, per cent	10	12	17	25
Brinell Hardness No.	250	225	200	185
Weight, pounds per cubic inch	0.275	0.278	0.280	0.285

bevel and worm gears; trunnion bearings; heavy-duty bearings; valve stems, bodies, and seats; pressure-tight castings; pump impellers; etc.

Welding Rod Applicable to Die-Cast White Metal

White metal die-castings have for years been considered unweldable. They are now said to be satisfactorily welded by employing a new patented process with a special welding rod known as "Aladdin" rod, which is made by the Aladdin Rod & Flux Mfg. Co., Grand Rapids, Mich. This rod produces a weld that is said to have as great strength as the base material. It is being used in welding shops for the welding of die-cast parts such as radiator grilles, lamp brackets, carburetor bowls, ornaments, and other die-cast products. The rod is used with the oxy-acetylene flame.

Chromium-Nickel Alloy for Furnace Mechanisms

Production heat-treating plants depend largely upon mechanical means for moving the work in and out of furnaces. Such units, therefore, as roller conveyor hearths, walking-beam conveyors, and racks for continuous enameling furnaces should be constructed of metals that have the ability to resist scaling action, are relatively non-warping, and retain a high degree of stress-carrying ability at temperatures up to 2000 degrees F.

For such service, the Calorizing Co., Wilkinsburg Station, Pittsburgh, Pa., has recently announced an improved chromium-nickel alloy known as Calite B-28, which was developed after a research conducted by the University of Michigan on thirty-two alloys containing from 25 to 28 per cent chromium and from 10 to 12 per cent nickel.

Precrimped and Prefinished Coils for Metal Stamping

When highly finished, crimped sheet metal is used for ornamental purposes in the manufacture of household appliances, novelties, electrical devices, etc., the metal usually has to pass through four distinct operations—stamping or forming, crimping, plating, and buffing. The American Nickeloid Co., Peru, Ill., is now marketing a material that requires only a stamping or forming operation, since it is obtainable in coils of all standard widths and lengths, precrimped and prefinished. This crimped coil material, known as "American Bonded Metal," is also applicable for paneling, table edges, displays, and window interiors, and toys and novelties of all kinds. The metal will not chip, peel, or tarnish.

A Bakelite Radio Housing 18 1/4 Inches High, 13 1/2 Inches Wide, and 10 3/8 Inches Deep—One of the Largest So Far Produced—is Now being Molded in a 500-ton Press by the Associated Attleboro Manufacturers, Inc. This Molded Part Weighs Ten Pounds. It Forms the Cabinet for the Pilot All-Wave Radio Receiver

Hardening High-Carbon Steel Tools

By W. T. KOEHLER

In hardening high-carbon steel tools that must be extremely hard, a very rapid rate of cooling is required to retain the martensitic or hardest condition of the steel. It is a well-known fact that quenching high-carbon steel entirely in cold water or brine is almost sure to cause cracks, especially if the pieces are not of uniform section, because of the enormous strains set up in the steel by the rapid cooling.

Many methods for overcoming this difficulty, such as putting about 2 inches of oil on top of the water quenching bath or heating the quenching bath, have been tried. Both of these methods, however, fail to give maximum hardness, due to the slowing up of the cooling effect. Another method is first to quench the piece in water or brine, removing it before it is cold, and then quench it in oil. This would be a very good quenching method if it could be timed properly.

It has been said that the ideal quenching medium is one that gives a very rapid rate of cooling in the quenching and tempering zones and a slow rate of cooling in the danger zone.

In order to meet these requirements as nearly as possible with the heat-treating equipment ordinarily available, the writer suggests a method whereby the hardener can time the piece while it is in the water or brine. First, the piece to be hardened is heated to the proper temperature and quenched in

HEAT TREATMENT RECORD

HARDEN			TEMPER		Make, Grade, and Temper of Steel	NAME OF ARTICLE	WHAT FOR
Date	Deg. F	Medium	Deg. F.	Medium			
	1450	Brine & Oil	375	Oil	HE-11	Punch Ring	20z. Bott Die #2

Fig. 1. Printed Form Used in Recording Heat-treating Method

brine, the hardener estimating the time, in seconds, that the piece is held in the brine. For example, let it be assumed that the piece should be held in the brine five seconds. The hardener plunges the piece in the brine quenching bath and begins to count the number of seconds decided upon, each count being about one second apart. On reaching the count of five, the piece is taken out and plunged into oil, where it remains until cold.

In timing the pieces while in the brine, there is no need of a watch or other timing device, the hardener depending upon his ability to count off the seconds, which can be done with a fair degree of accuracy after a little practice. If the tool is hardened satisfactorily, then a record of the heat-treatment is made, as shown in Figs. 1 and 2. After several of these records have accumulated, it is possible to duplicate the hardening results on any of the parts. The records also make it possible to

Date	Operator's Name	GENERAL INFORMATION
	W. T. K.	Held in brine 5 sec.

Fig. 2. Reverse Side of Heat-treatment Record Shown in Fig. 1

estimate more accurately the time similar pieces should be held in the quenching brine, bearing in mind that less time is required for light pieces and more time for heavier pieces. This method has proved very satisfactory and profitable in the shop where the writer is employed.

* * *

Machinery Exports Continue to Increase

According to information received from the Machinery Division of the Bureau of Foreign and Domestic Commerce, the United States exports of machinery in December were valued at $15,810,281, or 28 per cent above the December, 1935, shipments, which were valued at $12,360,766. The increase was fairly general and spread over all but one of the eight machinery groups, ranging from 60 per cent in construction and conveying machinery to 9 per cent in the textile, sewing, and shoe machinery group. The exports of power-driven metal-working machinery increased from $3,445,000 in December, 1935, to $3,914,000 in December, 1936.

Exports of practically all types of power-driven metal-working machines advanced during the entire year of 1936, the total value reaching $41,896,700, as compared with $27,090,700 for 1935. This is an increase of 55 per cent over the 1935 shipments. Metal-working machinery other than power-driven types increased at approximately the same ratio, the 1936 figures being $4,220,600, or 59 per cent above the 1935 shipments of $2,661,100.

The total exports of all kinds of machinery for 1936 aggregated close to $170,000,000, or 30 per cent above the exports for 1935, which were approximately $130,000,000.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.

Electrical Measuring and Recording Instruments

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia, Pa. Circular "Die-Out ND(1)," advertising the Leeds & Northrup "Silver Anniversary" Micromax recorder. The circular is of novel design, being cut to the actual shape of the recorder so that it is practically a half-size model. The door of the case can be opened and the chart carriage swung out, exposing the whole mechanism to view, just as in the real equipment. Although the range of this instrument is that of a typical temperature recorder, the model demonstrates equally well the automatic indicating and recording of any of a wide variety of process conditions.

Cemented Carbides

CARBOLOY COMPANY, INC., 29 E. Jefferson Ave., Detroit, Mich. Engineering bulletin TA-371, on the selection of cemented carbides. This bulletin contains much information of practical value to users or prospective users of cemented-carbide tools. It explains the necessity of considering (1) type of material being machined; (2) part to be machined; (3) machining specifications; and (4) type of machine used. An especially useful section of the publication is an alphabetical listing of iron, steel, non-ferrous metals, and non-metallic materials, with suggested grades of Carboloy for roughing and finishing operations on each material.

Grinding Wheels

NORTON CO., Worcester, Mass. New edition of a booklet containing grinding wheel specifications for grinding machines. The book covers standard and special shape grinding wheels and lists the correct size and type of wheel for different types of grinding machines. In this edition list prices have been included. The data is arranged in alphabetical order under the name of the grinding machine manufacturer, and there is an index of manufacturers and wheel shapes. Users of grinding machines will find this book of considerable value.

Monel Metal

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Publication entitled "Strength Plus—Monel for Mechanical Jobs," containing details on the properties and characteristics of Monel metal alloys. The larger part of the book is devoted to applications of these materials in a wide range of industries where corrosion resistance, combined with strength, is of importance as, for example, in hydroelectric plants, steam turbines, pumps, refrigerating equipment, ships, automobiles, railways, etc.

Contour Sawing Machines

CONTINENTAL MACHINE SPECIALTIES, INC., 1301 S. Washington Ave., Minneapolis, Minn. Handbook on contour sawing and filing, covering the history of band sawing and filing; contour saws and operating technique; comparison between the contour sawing process and other cutting processes; shop practice and methods of making punches and dies, jigs and fixtures, special parts, templets, cams, etc.; and miscellaneous applications. The different types of Do-All sawing and filing machines are illustrated, and specifications are included.

Electric Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Publication 32-165, entitled "Cubicle Type Switchgear for Indoor Service, with Manually or Electrically Operated Breakers." Catalogue Section 42-104, descriptive of Type OB switchboard watthour meters. Catalogue Section 42-210, descriptive of polyphase detachable meters. Leaflets 20627-A and 20628-A covering "De-Ion" combination line starters and "De-Ion" non-reversing line starters.

Turret Lathe Tools

GISHOLT MACHINE CO., 1209 E. Washington Ave., Madison, Wis. Catalogue illustrating and describing the Gisholt line of standard tools for the Nos. 3, 4, and 5 ram type universal turret lathes and other similar types of Gisholt turret lathes. The catalogue covers chucking tools, bar tools and cross-slide tools, as well as chucks, boring-bars and reamers, and machine attachments. In each case, the use for which the tool is especially adapted is given.

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletins GEA-2369, 2467, 2505, and 2525, treating, respectively, of General Electric "Thermo-Tector," an automatic-reset thermal overload switch for fractional-horsepower motors; General Electric light-sensitive cell; Type AF-1 circuit-breakers for office buildings and industrial plants; and temperature relays for protecting alternating-current machines and transformers against abnormal heating.

Mo-Max High-Speed Steels

CLEVELAND TWIST DRILL CO., 1242 E. 49th St., Cleveland, Ohio. Booklet entitled "The Molybdenum-Tungsten High-Speed Steels Marketed under the General Trade Name Mo-Max," prepared by J. V. Emmons, metallurgist for the Cleveland Twist Drill Co. The booklet gives information relating to the composition, performance, and economic value of Mo-Max steels, together with directions for their use.

Broaching Machines

COLONIAL BROACH CO., Detroit, Mich. Bulletins 104-9A, 9B, 9D, 9H, 9J, and 9K, illustrating and describing, respectively, broach sharpening

machines; single-ram surface broaching machines; hydraulic presses for light broaching and assembling; high-speed pull type broaching machines; popular-priced broaching machines for every purpose; and high-speed "pushers" for the continuous automatic broaching of small parts.

Precision Wires for Gear Measurements

VAN KEUREN CO., 10 Copeland St., Watertown, Mass. Circular G32, entitled "Measure Spur Gears with Van Keuren Precision Wires," describing a new and easy method of measuring the pitch diameter of spur gears with a series of standard wires. Simplified formulas, together with constants for 14 1/2- and 20-degree involute gears of from 9 to 200 teeth, are given.

Lubrication Equipment

ALEMITE DIVISION OF STEWART-WARNER CORPORATION, 1826 Diversey Parkway, Chicago, Ill. Catalogue entitled "Alemite Controlled Lubrication," containing 56 pages covering the entire range of Alemite industrial equipment, which includes hand guns, power-operated units, fittings, hose, valves, meters, etc. A section on hand gun repair parts is included.

Sprayed Molten-Metal Coating Process

METALS COATING CO. OF AMERICA, 495 N. 3rd St., Philadelphia, Pa. Folder 1207, entitled "Railroad Uses for MetaLayeR," containing illustrations of typical sprayed molten-metal coating operations in railroad shops, both for maintenance and production.

Variable-Speed Transmission

NEW DEPARTURE DIVISION OF GENERAL MOTORS CORPORATION, Bristol, Conn. Circular A-181, entitled "A Million Speeds at the Touch of a Finger," describing the features of the Transitorq, and showing typical applications of this variable-speed transmission

Tapping Machines

R. G. HASKINS CO., 4634 W. Fulton St., Chicago, Ill. Bulletin 36-T, describing the Haskins method of high-speed precision tapping and the various tapping machines made by the company. A new feature—the Haskins air control—is completely described.

Leather Belting

ALEXANDER BROS., INC., Philadelphia, Pa. Catalogue A-116, covering the Alexander line of leather belting and industrial leathers. This book also contains statistical information that should be of value to plant superintendents, operation managers, and purchasing agents.

Transmission Belts

UNITED STATES RUBBER PRODUCTS, INC., 1790 Broadway, New York City. Folder containing twenty-five reproductions of photographs taken in the field and factory, showing unusual installations of transmission belts in a variety of industries.

Arc-Welding Machines

HOBART BROS. CO., Box FR-173, Troy, Ohio. Catalogue on the new 40-volt simplified electric arc welding machine made by this company. The book contains many illustrations showing various jobs for which this machine is adapted.

Air Compressors

UNION-C MACHINE CO., INC., Union City, N. J. Catalogue containing specifications and illustrations of Union-C air compressors, which are made in two styles, single stage (Series No. 200) and two-stage (Series No. 300).

Valves

ROSS OPERATING VALVE CO., Detroit, Mich. Catalogue 36, covering the line of valves made by this company for the control of single- and double-acting air cylinders, such as are used on chucks, vises, lathes, and other machines.

Bonded Metals

AMERICAN NICKELOID CO., Peru, Ill. Circular showing the application of bonded, or pre-finished, metals in various electrical devices. Circular illustrating crimped coils made from bonded metal for trim and decoration.

Materials-Handling Equipment

LEWIS-SHEPARD CO., 175 Walnut St., Watertown, Mass. Folder 321, covering Lewis-Shepard equipment for handling barrels, drums, and cartons, including lift trucks, floor trucks, stackers, elevators, etc.

Metal-Spraying Process

METALLIZING CO. OF AMERICA, INC., 1218 Long Beach Ave., Los Angeles, Calif. Booklet showing pictorially a great number of applications in which the metallizing process has been used to advantage.

Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Application Sheet No. 52, containing information on the application of welding in machine design, with especial reference to miscellaneous small parts.

Restoring Flooded Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y., has issued several publications containing specific instructions for restoring flooded electric equipment to service.

Vibro-Insulators

B. F. GOODRICH CO., Akron, Ohio. Catalogue Section 7900, illustrating and describing Goodrich Vibro-Insulators for application on mechanical equipment to absorb shock and vibration and to reduce noise.

Knife and Saw Grinding Machines

SAMUEL C. ROGERS & CO., 191 Dutton Ave., Buffalo, N. Y. Illustrated price list covering this company's line of automatic knife and saw grinding machines.

Screws, Bolts, and Nuts

PHEOLL MFG. CO., 5700 Roosevelt Road, Chicago, Ill. General catalogue containing 108 pages listing the complete line of screws, bolts, nuts, and related products made by this concern.

Precision Measuring Tools

GEORGE SCHERR CO., INC., 124 Lafayette St., New York City. Circular illustrating and describing the new Chesterman height gage, designed especially for easy reading.

Arc-Welding Equipment

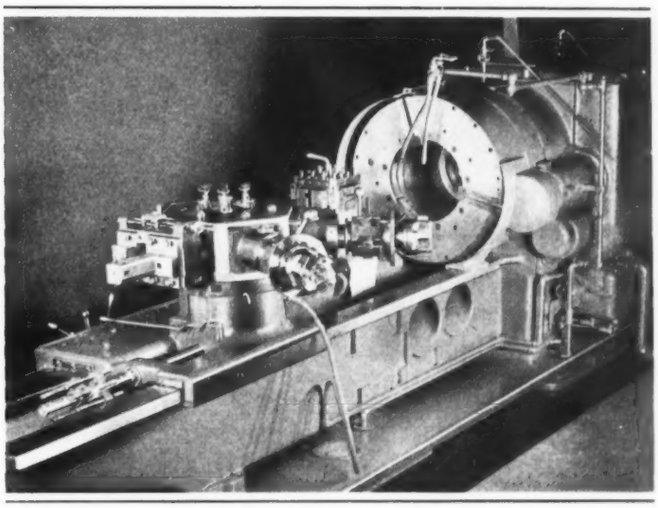
LINCOLN ELECTRIC CO., Cleveland, Ohio. Welder Specification Bulletin No. 317, covering the Lincoln "Shield-Arc S A E" welder of 200, 300, 400, and 600 amperes.

Cutting Oils

SWAN-FINCH OIL CORPORATION, 205 E. 42nd St., New York City. Circular pointing out the advantages of Safco cutting oils for operations on machine tools of all types.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market



Gisholt Heavy-Duty Turret Lathes

Anti-friction tapered roller bearings and an unobstructed bore 16 1/2 inches in diameter are notable features of the spindle of the heavy-duty turret lathe shown in the heading illustration and in Fig. 1. This machine is one of numerous similar types built recently by the Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis., for machining large steel forgings.

The spindle is equipped with a Gisholt 34-inch, three-jaw, hydraulic chuck. The heading illustration shows the turret tooled up for performing such operations as boring, turning, facing, and tapping. The chuck is operated by oil pressure from a separate hydraulic unit, and is designed to hold a variety of forgings.

The lead-screw is used in feeding both the cross-slide carriage and the hexagon turret carriage. This lead-screw feed is of advantage in leading the large collapsing taps into the work at the proper rate. Because of the amount of stock to be removed in cutting the thread in the forgings machined with the setup shown, two taps are used, one for roughing and one for finishing the thread.

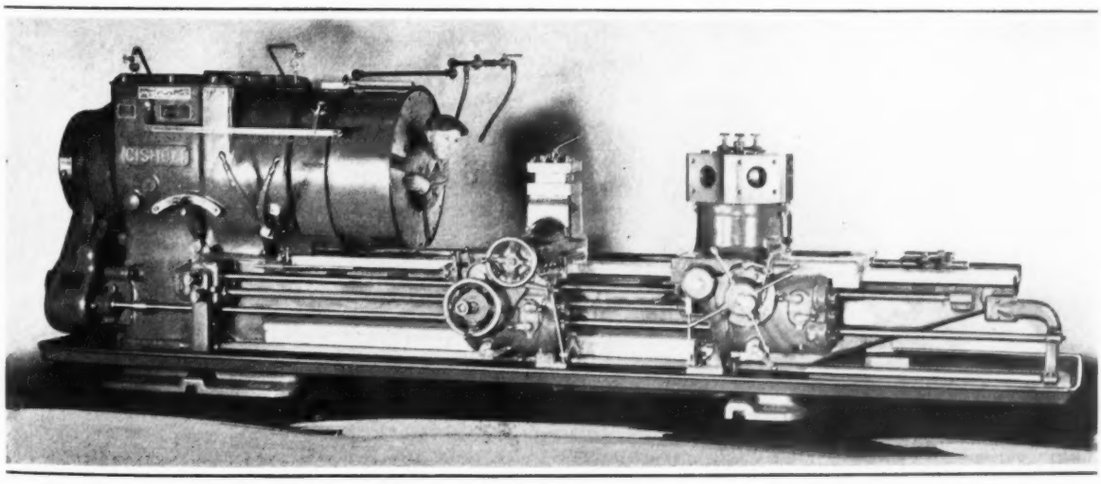


Fig. 1. Gisholt Heavy-duty Turret Lathe Built for Machining Large Forgings

The hexagon turret is equipped to deliver cutting compound to the various tools on each of the six turret faces. A special force-feed oiling system, built into the machine, lubricates the anti-friction bearings on the spindle and the other headstock bearings, as well as the gears and other parts. This system insures perfect lubrication and contributes greatly to the maintenance of accurate alignment of the spindle by reducing the temperature changes in the spindle bearings to a minimum.

Another feature of this machine is the hardened steel ways on the bed, which assure long life and the maintenance of accurate alignment of the bed and spindle. The one-piece bed and headstock is cast from a special semi-steel composition. All gears are of hardened steel and the shafts are mounted in anti-friction bearings.

Power longitudinal rapid traverse to both carriages provides for speed and ease of operation. Large dials on both carriages enable the operator to observe the length of the cuts easily. An adjustable longitudinal trip and stop-roll is provided for both the hexagon turret and the toolpost carriages. The chuck is stopped quickly upon the completion of the operation by means of the automatic spindle brake.

Cimatool Gear-Tooth Chamfering Machines

A high-speed gear-tooth chamfering machine, available in three different models for chamfering and burring operations at a production rate as high as 600 teeth per minute, has been brought out by the Cimatool Co., E. Third and June Sts., Dayton, Ohio. The three models are known as 4-A, 4-B, and 4-C, and all are available for either air, hydraulic, or manual operation. These machines utilize hollow-mill cutters, and the cutter-heads are provided with rapid traverse to and from the cutting position. During the cutting period, the spindles are located against an adjustable back-stop.

The 4-A is the smallest machine, consisting of a single work-head and a single cutter-spindle, mounted on one base. The 4-B model, shown in Fig. 1, has a single work-head with two cutter-spindles, both designed to machine a single part simultaneously. The 4-C machine consists primarily of two 4-A machines mounted on a single base or two complete single-spindle machines on one base.

With the 4-A machine, the teeth on only one face of the gear can be chamfered at one time, while with the 4-B machine, the inner and outer faces of a ring or bevel gear may be chamfered simultaneously or the two cutter-spindles may machine similar gear teeth on the same face of the gear but on opposite sides, so that 1/2 revolution of the part serves to complete the chamfering of one face of the gear. The 4-C model, combining two of the single-spindle machines, enables the operator to load one part on one work-head while the other half of the machine is employed for chamfering operations on another part.

The machine can be completely hand-operated or, at an addi-

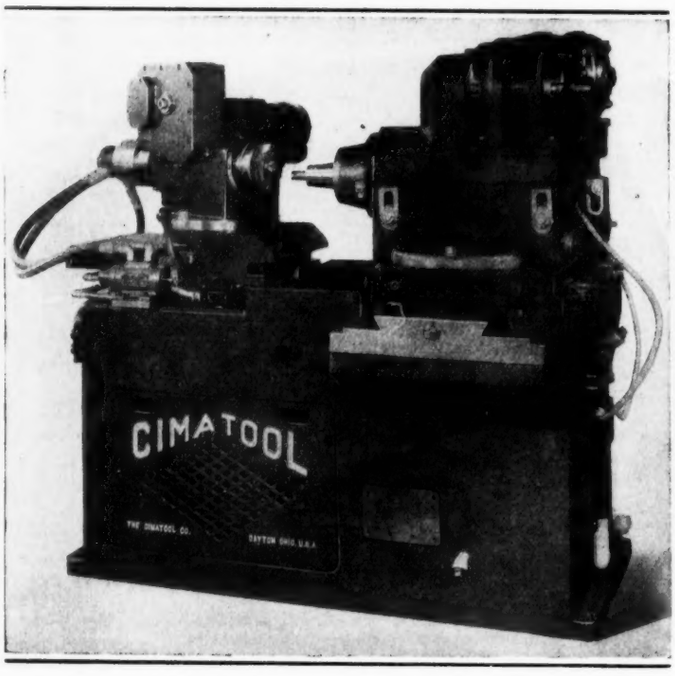


Fig. 1. Cimatool 4-B Gear-tooth Chamfering Machine Having a Single Work-head and Two Cutter-spindles

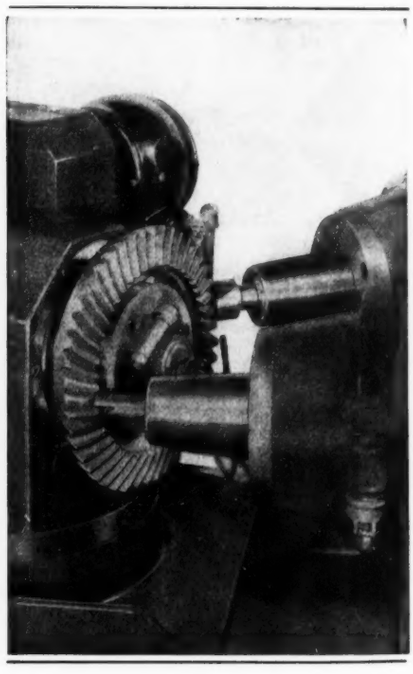


Fig. 2. Close-up View of Work on Machine Shown in Fig. 1

tional cost, can be equipped for complete automatic operation. In the latter case, a time mechanism is furnished as an integral part of the machine. With this equipment, the operator simply presses a button to automatically clamp the work, engage the quick traversing movement of the cutter-spindle, index the part, feed the cutter, and return the cutter-head to the loading position. The machine is also shut off and the work released automatically.

"Flexi-Weld" Portable Spot-Welder

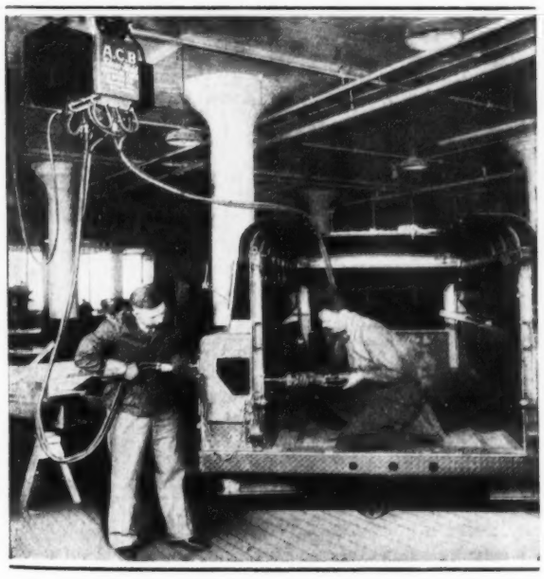
Flexibility is an outstanding feature of a portable spot-welder placed on the market by the American Coach & Body Co., Cleveland, Ohio. The field of application of this welder, for which patents are pending, covers practically all products fabricated from sheet steel up to 16 gage. It is especially adapted for welding operations on automobile and truck bodies, refrigerators, metal furniture, stoves, and air-conditioning equipment which, because of its size and shape, necessitates bringing the welder to the work. Sheathing of 16 gage or lighter can be spot-welded to channel, angle, or tubular frame material of any thickness.

The welder consists of an especially designed transformer which may either be suspended from a trolley or gib crane or mounted on a truck. Two light-weight insulated cables terminate in separate electrodes, which weigh only 10 pounds each. An operator can handle these electrodes on continuous production without undue fatigue. The separate electrodes permit one operator to work inside a body while another operator works on the outside. It is not necessary for one electrode to be exactly opposite the other in order to make satisfactory welds; in fact, the electrodes can be separated by as much as 5 feet and still produce reliable welds.

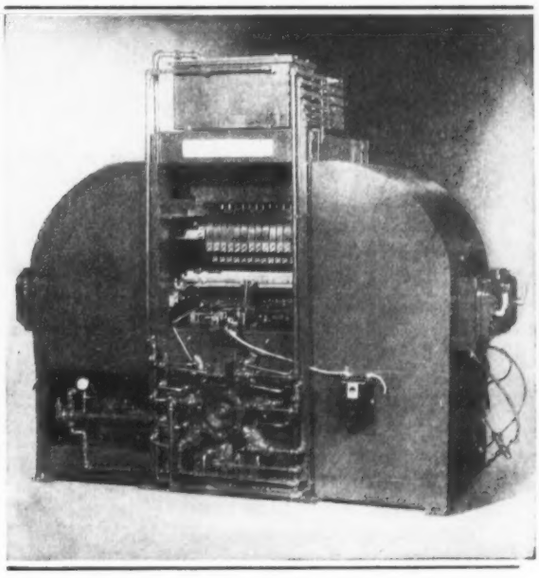
The advantages claimed for this welder include the elimination of costly electrode guns and yokes; welding in any place that can be reached with a simple individual electrode; the welding of 18-gage or thinner stock by clamping one electrode to the work and using the other for making any welds required within a radius of 5 feet; very rapid welding, due to the light-weight electrodes which can be moved quickly from one spot to another; assurance of good welds, because sufficient pressure must be put on the electrode before the welding current will flow; and the automatic timing of the weld. The welder shown is being used in continuous production.

Thomson-Gibb Spot-Welding Machines

Four transformers, a series of hydraulic plungers that are actuated in rotation to make a number of welds, a special work-carrying table, and an indexing arrangement for use in making rows of spot welds at fixed positions across the work are features of the "Multi-Spotmatic" welding machine brought out by the Thomson-Gibb Electric Welding Co., Lynn, Mass. The control valves at the front of the machine control the pressure and duration of the current flow for each individual weld and permit variation in the thickness of the metal being welded.



Welding with "Flexi-Weld" Spot-welder Having Two Separate Electrodes



Thomson-Gibb Hydraulically Operated Spot-welding Machine

An aluminum spot-welder (not shown) has also been built by this company under a government contract and specifications, for installation at flying fields in different parts of the country. The entire outfit includes the welder proper, with its main welding transformer and a separate auto transformer, and two elaborately equipped electronic control panels.

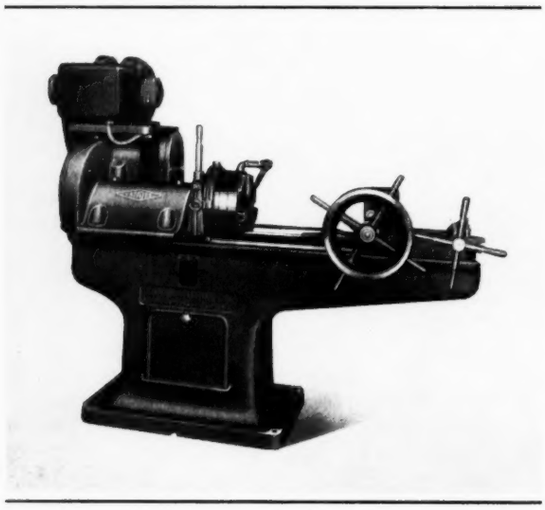
An interesting feature of this machine is that it is constructed largely of aluminum. A signal bell is provided to warn the operator if the proper welding conditions are not maintained. There is also a recording device which charts the value of the current flow after each weld is made, so that inspectors can check up on any weld that appears to be of doubtful quality.

Landis Improved 2-Inch Threading Machine

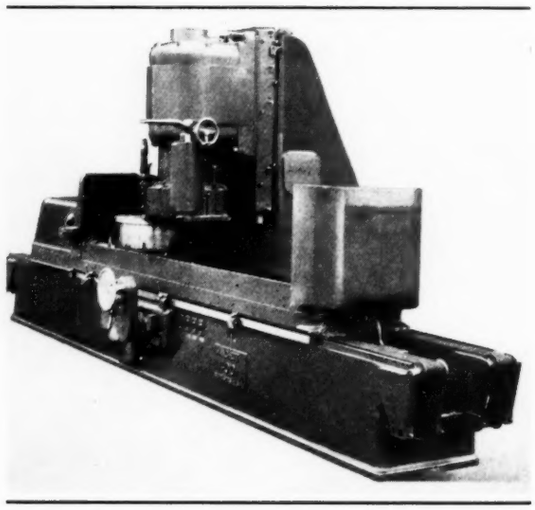
An improved design of the 2-inch threading machine made by the Landis Machine Co., Waynesboro, Pa., is being placed on the market in both belt- and motor-driven types. Power is delivered to the belt-driven machine through tight and loose pulleys mounted on the main driveshaft. The drive is directly from a lineshaft without a countershaft, a belt-shifter being provided for starting and stopping the machine.

Changes in speed are obtained by pick-off gears on the headstock, the gears regularly supplied covering a range of 31 to 118 revolutions per minute. A plate on the gear-box shows the proper gears for the various speeds.

In the motor-driven machine the motor is mounted on top of the headstock, as shown in the illustration. The drive from the motor to the gear-box is by a silent chain. The machine bed has been strengthened by making it thicker and by adding heavier reinforcing webs. The headstock is mounted directly on top of the bed. The coolant pump is mounted close to the machine bed to save floor space. The machine is provided with either the Landis standard rotary diehead or the heat-treated Lanco head, and can be furnished with or without a lead-screw. The new machine is slightly heavier than the previous machine, but requires practically the same floor space.



Landis Motor-driven Threading Machine of Improved Design



Hanchett Vertical-spindle Surface Grinder with Rotating Magnetic Chuck

Hanchett Vertical-Spindle Surface Grinder

A surface grinder, known as the No. 400 Series, equipped with a built-in 30-horsepower motor having a speed of 700 revolutions per minute has been brought out by the Hanchett Mfg. Co., Big Rapids, Mich. This machine can also be equipped with a 40-horsepower motor. The grinding wheel is 22 inches in diameter, 4 inches high, and has a 2-inch face, and is available in either the cylindrical or segmental type. These machines are built in all lengths from 50 to 132 inches. The table has T-slots, is 18 inches wide, and can be had in any desired length. It is hydraulically operated, speeds up to 90 feet per minute being available. The grinding wheel head is provided with hand, power, and automatic feeds.

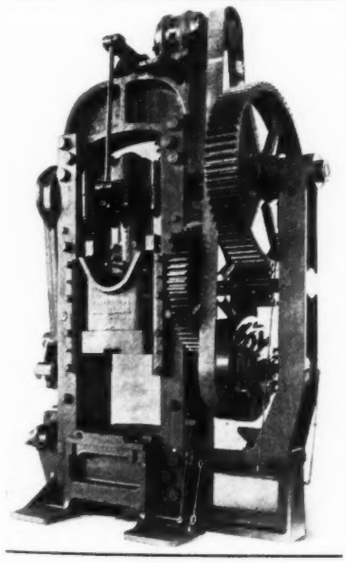
A rotating magnetic chuck, 24 inches in diameter, located at one end of the table, is driven by a separate motor through a variable-speed unit. This chuck can be easily removed, and a rectangular chuck or fixtures applied to the table in the usual manner. The machine is provided with patented belt covers for the table ways, a wheel-

dressing device, and a motor-driven coolant system, including a large coolant tank. The machine in the 86-inch length, with all equipment, weighs 25,000 pounds.

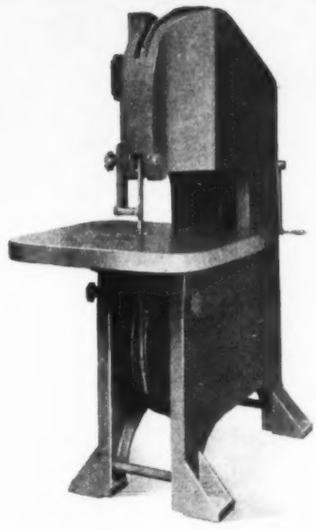
Chambersburg Double-Geared Trimming Press

A 300-ton double-geared trimming press equipped with an air-operated clutch, as shown in the illustration, has been added to the line of the Chambersburg Engineering Co., Chambersburg, Pa. Like all other trimming presses made by this company, the new machine has patented forged-steel side frame construction, an over-size crank, and outboard bearings.

The new air-operated clutch makes the machine extremely easy to control, and is designed to slip in the event of excessive overloads. The machine has a stroke of 8 inches and an adjustment of 5 inches. The bolster is 5 inches thick, and measures 37 inches from left to right and 40 inches front to back. The ram face is 30 by 30 inches, and the distance between the frames is 40 inches. The drive is by a single 20-horsepower constant-speed motor. The weight of the machine is 68,000 pounds.



Chambersburg Trimming Press



Grob Continuous-motion Filing Machine

Grob Large-Throat Continuous-Motion Filing Machine

A floor type heavy-duty continuous-motion filing machine with a 24-inch throat has been added to the line of filing machines made by Grob Bros., Grafton, Wis. This machine, designated Type D3, is built to withstand severe usage. The chain on which the individual files are fastened has a positive drive, so that no matter how hard the work is forced against the files, there is no slippage.

The files are guided over a hardened support. The file chain and the files are made by the manufacturers of the machine and are furnished in flat, oval and half round shapes. Chains of abrasive stones for lapping hardened dies can also be supplied for use with these machines.

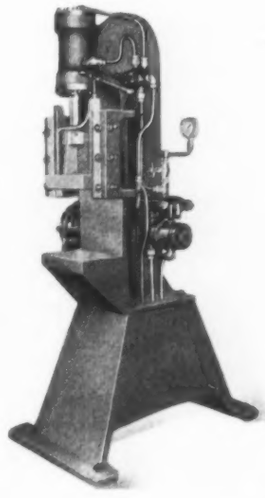
By simply moving the hand-lever shown at the right of the machine, the tension on the file chain is released, so that it can be changed or inserted in an opening in the work. All revolving members are mounted on ball bearings, and the machine is driven by a 1/2-horsepower motor. Three speeds are provided. The distance from the floor to the table is 45 inches. The table is 30 by 30 inches, and the total height of the machine is 77 inches. The weight is 2000 pounds.

Greenerd Six-Ton Hydraulic Press

A controlled even pressure can be applied or held on work indefinitely with the six-ton hydraulic press designated No. 57, which has recently been brought out by the Greenerd Arbor Press Co., Nashua, N. H. This press can be stopped at any point of either the upward or downward stroke by means of a hand-lever.

A three-horsepower motor and pump are mounted on opposite sides of the main housing, and the pump is connected between a twenty-gallon sump in the base and a hand-operated control valve. A knockout adjustment controls the length of the return stroke. The hand control lever regularly supplied must be tripped to start both the down stroke and the up stroke, but the machine can be furnished to give one complete cycle, down and up.

The pressure can be adjusted from 1/2 ton to 6 tons on the down stroke. A 3-ton pull can be exerted on the up stroke. The



Greenerd Hydraulic Press

ram is 2 7/16 inches in diameter and has a 5-inch stroke. The distance of the cross-head from the platen or working table is 10 inches. The work-table is 12 inches wide by 8 inches deep, and the distance from the center of the cross-head to the back of the throat is 5 inches.

Stanley "Victor" Electric Drill

Stanley Portable Electric Drill

An electric drill of 1/2 inch capacity, designated No. 124 "Victor," has been added to the line of portable tools made by the Stanley Electric Tool Division of the Stanley Works, New Britain, Conn. This drill has been designed to meet the requirements of contractors, automotive mechanics, plumbers, and oil-burner installers and for other service requiring the drilling of wood and metal. The motor is mounted on seal type ball bearings. The drill has an aluminum alloy housing and is equipped with a three-jaw chuck.

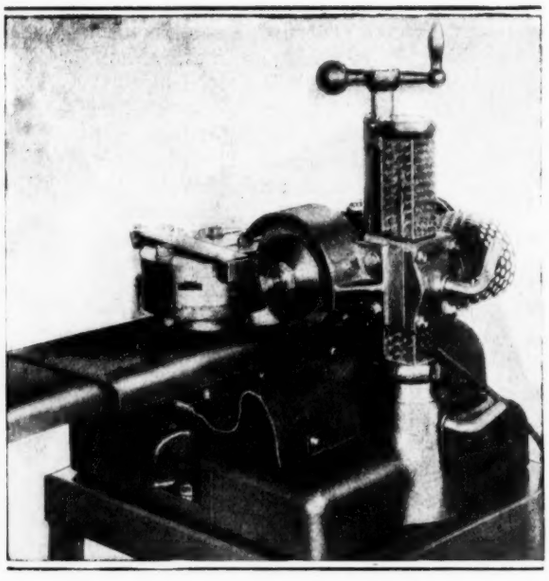
The new drill has a combination spade and breast-plate handle and a pipe handle that can be detached when the tool is being used in close quarters. The no-load chuck speed is 500 R.P.M., the length 15 1/2 inches, and the weight 12 1/2 pounds.

Oster Grinder for Threading Dies and Chasers

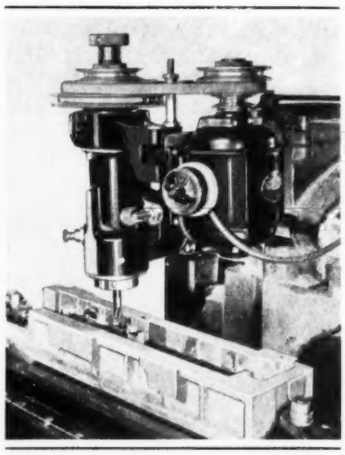
A machine designed for grinding threading dies and chasers of all kinds, which is equipped with a special fixture and wheel for each type of chaser to be ground, has just been placed on the market by the Oster Mfg. Co., 2057 E. 61st Place, Cleveland, Ohio.

This grinder is so designed that it can be operated by anyone, regardless of their experience in grinding dies and chasers. Micrometer adjustments make it possible to obtain an accurate cutting edge and lead. A special, thin type grinding wheel facilitates grinding out broken teeth.

The grinder is small and compact, and is operated by a universal motor which can be connected to the ordinary light socket. The equipment regularly supplied consists of one set of special fixtures and wheels for grinding any one type of chaser, a universal motor, and a dressing stick for the grinding wheels. A welded-steel stand with a built-in shelf for extra fixtures can be furnished as extra equipment when desired.



Oster Chaser and Threading Die Grinder with Micrometer Adjustments



Speed Head Brought out by the American Tool & Die Co.

Speed Head for Milling and Grinding Operations

A speed head for heavy-duty high-speed milling and grinding operations, which can be attached by means of an adapter to any type milling machine, has been brought out by the American Tool & Die Co., 439 E. Fort St., Detroit, Mich. The head is anchored close to the mounting support and can be tilted to any compound angle. The spindle is 2 inches in diameter, has a 1 1/8-inch bore, and is designed to permit using long end-mills and large fly cutters with safety.

The balanced V-type aluminum pulleys provide six speeds ranging from 650 to 4600 R.P.M. A 1/2-horsepower, ball-bearing, 220- to 440-volt, 60-cycle, three-phase motor is used, which has a speed of 1750 R.P.M.

The standard equipment includes the motor, switch, draw-bar collet nut, belt, belt guard, and adapter. The adapter regularly furnished will fit either the No. 3 or No. 4 Van Norman milling machine. Adapters can be furnished that enable the speed head to be mounted on other milling machines.

Cross Gear-Tooth Rounding, Pointing, Chamfering, and Burring Machines

To complete its line of gear-chamfering equipment, the Cross Gear & Machine Co., 3250 Bellevue Ave., Detroit, Mich., has brought out two gear-tooth burring machines, designated Nos. 70 and 71; also single-spindle and double-spindle gear-tooth pointing machines, designated Nos. 40 and 41, respectively; as well as an improved model of the No. 35 gear-tooth rounder described in February, 1935, MACHINERY, page 380.

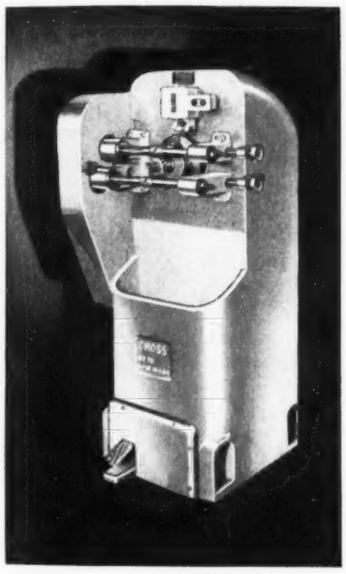


Fig. 1. Cross No. 70 Machine for Removing Burrs from Both Ends of Gear Teeth Simultaneously

The Nos. 70 and 71 machines, shown in Figs. 1 and 2, are fully automatic, and are designed for economical removal of burrs and sharp edges from internal and external spur and helical gear teeth, straight and spiral bevel gear and pinion teeth, and internal and external straight and helical splines.

With the two-spindle machine (Fig. 1), the average automobile transmission gear with helical teeth can be burred and chamfered at the rate of approximately 240 gears per hour. The average cutter cost is about 50 cents per 10,000 gears. The cutters can be adjusted individually to remove more or less material. The air-operated work-holding clamps are controlled by a foot-pedal, leaving both hands free for fast loading.

Versatility and flexibility are features of the No. 40 single-spindle and the No. 41 double-spindle gear-tooth pointing machines. A simple change in set-ups adapts these machines for drilling, profiling, or gear-tooth burring and chamfering operations. An electric push-button controls the traverse of the cutter-spindle for loading operations, and a foot-pedal controls the work-holding clamps. Both the single-spindle machine and the double-spindle machine shown in Fig. 3 will take gears of 2 diametral pitch or finer having face widths up to 10 inches and diameters up to 20 inches. The regular indexing mechanism provides a range of from 8 to 150 spacings.

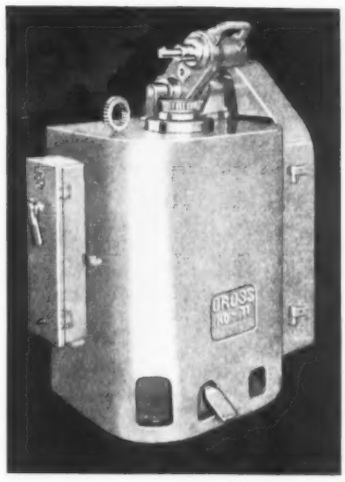


Fig. 2. Gear-tooth Burring Machine for Internal Operations

The improved No. 35 gear-tooth rounder functions on the same basic principles as the model previously described. The mechanism of the improved machine, however, has been entirely redesigned to give higher production and increased accuracy, as well as lower cutter costs.

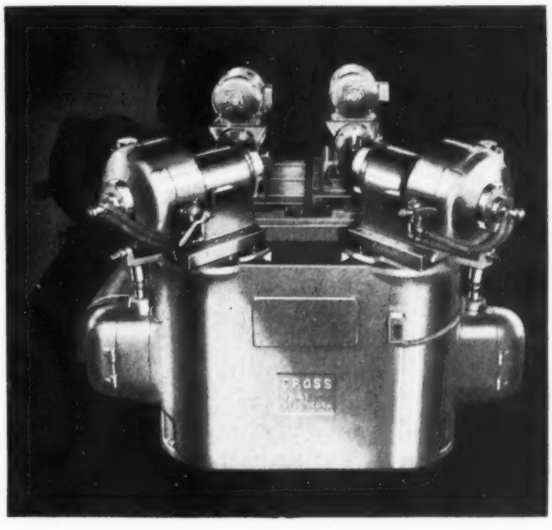


Fig. 3. Cross No. 41 Gear-tooth Pointing and Chamfering Machine

Westinghouse Midget Contactors and Starters

A line of remote-controlled, reversing and non-reversing magnetic starters for small single-phase and polyphase squirrel-cage induction motors has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The non-reversing contactors are particularly adapted for use with motors employed for driving air-conditioning equipment, small compressors, pumps, oil burners, fans, and small machine tools.

Both reversing contactors and reversing line-starters are available in the following sizes: 1 horsepower, 110 volts, three phase; 1/2 horsepower, 110 volts, single phase; 1

horsepower, 220 volts, three phase; and 1 horsepower, 220 volts, single phase.

Portable Spot-Welding Unit

A portable hydraulic spot-welding gun, together with the transformer pressure booster, cables, etc., required to comprise a complete unit for low- or high-production welding in the assembling of sheet-metal parts, has been brought out by the Progressive Welder Co., 737 Piquette Ave., Detroit, Mich. The hydraulic feature provides the correct pressure on the parts to be welded, resulting in perfect fusion of the metals. Fingertip control for the adjustment of the pressure makes possible the welding of the same or different gages of metal with equal facility. A simple hand-operated switch is provided to vary the output in accordance with different gages of material and welding conditions.

The complete unit is readily installed on the production line, since it need only be connected to the air, water, and electrical supply lines to start welding operations. The overhead mounting of the unit on a swivel type hanger gives a working radius of approximately 12 feet.

Spot-welding with Equipment Made by Progressive Welder Co.

Mechanical Counter Made by Production Instrument Co.

Mechanical Stroke Counter

A mechanical counter designated Type SMC-1, which is particularly adapted for built-in applications on small machines, has been placed on the market by the Production Instrument Co., 1325 S. Wabash Ave., Chicago, Ill. The counter registers up to 99,999 strokes. It is only 1 7/8 by 1 1/2 by 1 3/4 inches in size and is of the non-reset type. It is operated by a short lever throw of 1/2 inch. The brass case of the counter is cadmium-plated.

Struthers Dunn Electrical Counters

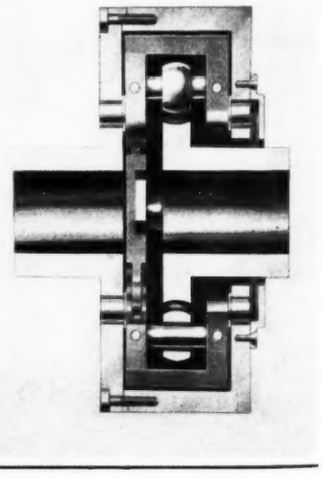
A new line of electric counters with five digits, made in both the reset and non-reset types, has been brought out by Struthers Dunn, Inc., 139 N. Juniper St., Philadelphia, Pa. The indicating wheels are geared together, so that the load on the operating mechanism is constant, being the same when counting 1 or 10,000. This arrangement eliminates any tendency for the counter to skip.

Harris Self-Aligning Coupling

A Model C universal, self-aligning coupling designed for medium- and heavy-duty continuous, intermittent, and reversing drives has been placed on the market by the Harris Coupling Co., 265 W. 40th St., New York City. This coupling allows parallel misalignments up to 3/16 inch in any radial direction, angular displacement up to 15 degrees, and an endwise float of 1/2 inch. It operates on the same basic principle as the Model A, described and illustrated in February MACHINERY, page 422, the main difference being that bellcranks connected by links are used instead of gear segments in the operating mechanism.

The mechanism consists essentially of four double-web cranks, two of which are shown in the accompanying cross-sectional view. The cranks or oscillating members are held in their relative positions by the bellcranks and connecting links. The driving pins are supported at both ends instead of one end as in the Model A coupling.

The new coupling is regularly made in five sizes, the No. 1 size having a capacity for transmitting 3.7 horsepower per 100 revolutions per minute at speeds up to a maximum of 3000 revolutions per minute, while the largest or No. 5 coupling transmits 39.1 horsepower per 100 revolutions per minute at speeds up to 3000 revolutions per minute. The shaft sizes for this line of couplings range from 1 3/8 inches up to 2 1/2 inches, but couplings of this type can be made to meet any horsepower requirements.

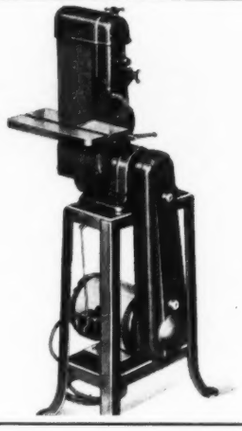


Cross-sectional View of Harris Model C Coupling

Delta Belt Surfacer

A completely enclosed 6-inch belt surfacer designed to handle a wide range of sanding, surfacing, and finishing operations has recently been placed on the market by the Delta Mfg. Co., 617 E. Vienna Ave., Milwaukee, Wis. The versatility of this machine enables it to be used not only for finishing metal parts with aluminous-oxide and silicon-carbide belts, but also for surfacing and finishing parts made of Bakelite, Catalin, and other plastics, bone, tile, asbestos, etc.

This machine can be used as either a horizontal or a vertical sanding machine for surfacing or shaping wood parts. In the horizontal position, it may be fitted with a wood fence and an adjustable back-stop to guide and stop the work. In the vertical position, it may be fitted with a tilting table that permits a wide variety of angular sanding.



Delta Belt-surfacing and Sanding Machine

The machine is completely equipped with self-sealed ball bearings, which are supplied with sufficient lubricant to last for the life of the bearings. The drums that carry the sanding and finishing belts are designed to eliminate the necessity of using rubber coverings. The complete enclosure of every part of the belt and drive mechanism conforms to safety requirements and enables an efficient dust-collecting system to be employed.

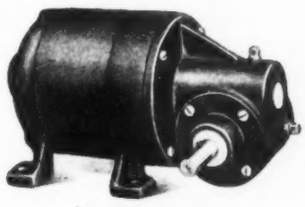


Fig. 1. Foote Single-reduction Worm-gear Motorized Unit

Foote Motorized Speed Reducers

The Foote Bros. Gear & Machine Corporation, 5319 S. Western Blvd., Chicago, Ill., has recently added to its regular line of equipment a complete line of fractional-horsepower, motorized speed reducers designated IXL fractional-horsepower "powered gears." These units range from 1/50 to 3/4 horsepower and cover reduction drive ratios from 2 to 1 up to 8000 to 1. The various types include single- and double-reduction worm-gear units, single-reduction helical gear units, and combination worm-gear and planetary gear units for the higher ratios.

This line of speed reducers has been developed to meet practically every requirement in the fractional-horsepower field. The units can be directly coupled to the driven equipment or the slow-speed power can be transmitted by means of chain and sprockets or vee or flat belts. A wide range of mounting positions in both flange and foot types is possible. A single-reduction worm-gear unit, furnished in 1/20 to 1/8 horsepower sizes with ratios from 4 to 1 up to 72 to 1, is shown in Fig. 1. This unit, designated VX, has thirty-two possible mounting positions. In Fig. 2 is shown a double-reduction worm-gear unit available in sizes ranging from 1/8 to 1 1/2 horsepower, with ratios from 96 to 1 up to 8000 to 1.

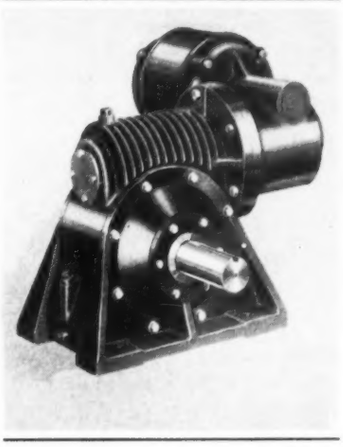
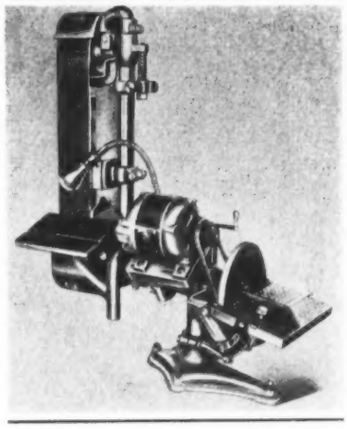


Fig. 2. Foote Double-reduction Worm-gear Motorized Unit



Walker-Turner 3-in-1 Universal Surfacer

Walker-Turner Universal Belt and Disk Surfacer

A machine designated the 3-in-1 universal surfacer, on which abrasive belt, disk, and stroke surfacing can be done, has been brought out by the Walker-Turner Co., Inc., Plainfield, N. J. This combination machine is adapted for surfacing wood, metal, plastics, fiber, bone, cork, and other materials. The "stroke" sanding feature enables the operator to surface large areas and panels up to 36 inches wide and of any length. In stroke surfacing, the work is moved under the horizontal abrasive belt, pressure being applied with a stroking block.

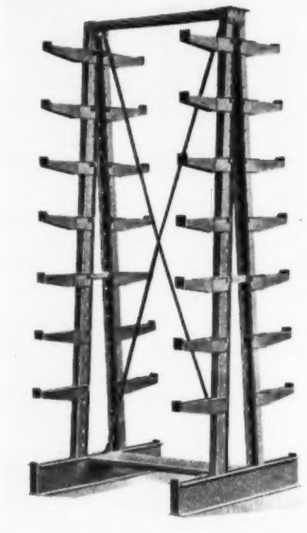
The abrasive belt can be quickly shifted to a vertical position for ordinary sanding operations.

The disk sander is particularly suited for finishing mitered pieces. The belt is 4 inches wide, coated with aluminous oxide abrasive and backed with fabric. The sanding disk is 10 inches in diameter.

Rack for Pipe and Bar Stock

A rack of heavy construction, consisting of two upright assemblies made up of posts, brackets, and base channels, as shown in the accompanying illustration, has been brought out by the General Fireproofing Co., Youngstown, Ohio, for storing piping and bar stock. The upright assemblies are connected at the top and bottom by formed channel plates and by diagonal stay braces. The base is of heavy 6-inch channels, and the posts are 2- by 3-inch channels. Brackets for carrying the load of pipe or bars are bolted to the posts, which are punched at 3-inch intervals for space adjustment.

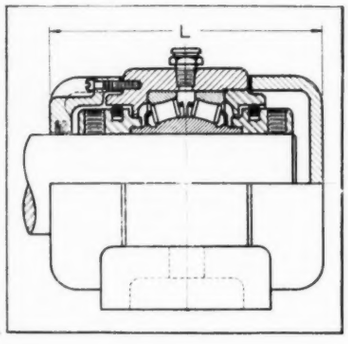
Each bracket will support a load of 2000 pounds, and has a front lip and a clear depth of 12 inches. Standard shelves of 12-inch depth may be placed on the brackets when required.



Pipe and Bar Stock Rack Made by the General Fireproofing Co.

Auxiliary Cap Seals for Shafer Bearings

Dustproof and dirtproof seals have been developed by the Shafer Bearing Corporation, 35 E. Wacker Drive, Chicago, Ill., for its line of roller-bearing pillow blocks. These seals or shielding caps are intended for use under exceptionally dusty and dirty conditions, for slow-speed applications, and for other installations requiring additional protection for the bearing. The seals are available in two styles —the open-end type and the closed-end type—and in a full range of sizes to fit all the standard-duty roller-bearing pillow blocks made by this company.

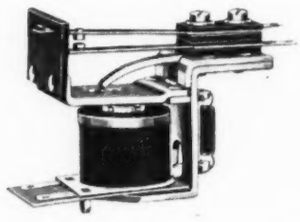


Shafer Roller-bearing Pillow Block with Auxiliary Seals

The seals are regularly furnished with felt closures, but other types of closures may be provided for exceptionally wet operating conditions or for certain extremely dirty conditions. The length *L* over the ends of the seals, as shown in the accompanying illustration, ranges from 4 1/2 inches for the smallest, or 3/4-inch, shaft bearing up to 13 1/4 inches for the 7-inch shaft bearing.

Guardian Compact Relays

A new Series 110 relay has been brought out by the Guardian Electric Mfg. Co., 1622-R W. Walnut St., Chicago, Ill., to meet the demand for a compact, flexible, and economical unit for alternating-current service. The standard 110 relay draws a current of approximately 2 watts and is supplied to operate on any voltage up to 220 volts. A double-pole, double-throw relay is only 2 3/4 inches in length, 7/8 inch wide, and 1 13/16 inches high.



Guardian Series 110 Alternating-current Relay

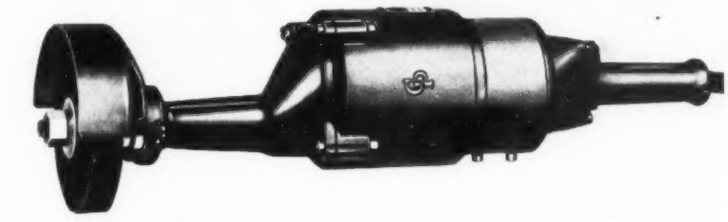
A direct-current type relay, which is designated Series 115, has the same features as the alternating-current type. These relays are available in base-mounted as well as bank-mounted assemblies.

Wiregrip Carded Belt Hooks

A new line of "Wiregrip" carded belt hooks has been added to the line of flexible belt lacing made by Armstrong-Bray & Co., 308-310 N. Sheldon St., Chicago, Ill. These Wiregrip belt hooks are mounted on special processed cards that hold the hooks firmly, so that the desired number of hooks can be easily cut off without destroying or disturbing the remaining ones. These hooks can be applied with any standard lacer or with a Wiregrip belt-lacing machine.

Portable Electric General-Purpose Grinders

Notable wheel economy through sufficient power to maintain high speed under load and freedom from dust troubles and overheating through the provision of a totally enclosed, fan-cooled motor are features of the 950-G



General-purpose Grinder Brought out by the Chicago Pneumatic Tool Co.

and the 970-G grinders recently added to the line of universal electric tools made by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. These grinders are designed to serve as production units for general-purpose grinding, and, with the proper wheel equipment, for wire-brushing, buffing, and polishing metal surfaces.

The motor is completely encased in a copper shield which excludes dust and conducts the motor heat to the cooling air. A fan forces a strong current of air over this shield and out over the gear-case on the work.

Ball bearings of ample capacity mounted in steel inserts cast integral with the housing are used throughout. The No. 950-G grinder takes a wheel 5 inches by 3/4 inch, has a free speed of 4500 revolutions per minute and a loaded speed of 2700 revolutions per minute, and weighs 13 3/4 pounds. The No. 970-G grinder takes a wheel 6 inches by 1 inch, has a free speed of 3900 revolutions per minute and a loaded speed of 2600 revolutions per minute, and weighs 22 pounds.

Mathews Ball-Bearing Conveyer Rollers

Two types of conveyer rollers, both suitable for heavy-duty service, have been added to the line of conveyer equipment made by the Mathews Conveyer Co., Ellwood City, Pa. Both types have double seals which protect the ball bearings from foreign matter.

The Type 63 SB, shown in the upper view of the illustration, is available in 4-, 4 1/4, and 4 1/2-inch diameters, and in lengths from 6 to 48 inches, with load

Mathews Conveyer Rollers for Heavy-duty Service

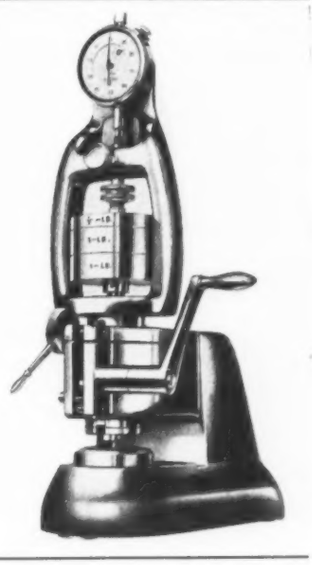
ratings ranging from 3000 to 5000 pounds. The Type 105 SB roller, shown in the lower view, is available in a 5-inch diameter size and in any length within practical limits. The latter type roller has a continuous load rating of 8000 pounds per roller. Both types have hexagon axles which prevent the inner raceways from rotating.

Van Keuren Gear-Measuring Wires

A set of wires for use in measuring the pitch diameter of either 14 1/2- or 20-degree involute gears having any number of teeth from 9 to 200 has been placed on the market by the Van Keuren Co., 12 Copeland St., Watertown, Mass. This set of wires has been developed to simplify calculations and is furnished with complete formulas and tables showing how to make pitch diameter measurements. The wires are contained in twenty labeled bottles which fit into a case with a hinged cover.

Federal Hardness Testing Gage

A testing gage, designed in accordance with the American Society for Testing Materials standards, for use in determining the hardness of rubber, cork, felt compositions, and similar materials has been brought out by the Federal Products Corporation, 1144 Eddy St., Providence, R. I. The gage is so designed that a true determination of the amount of penetration is obtained, variations caused by surface irregularities being eliminated by first pressing the material a fixed amount and then allowing the penetrating point to find its own resting point. Constant pressure is maintained throughout the test by weights made to conform to A.S.T.M. standards. The maximum thickness of sample that can be tested is 1 inch.

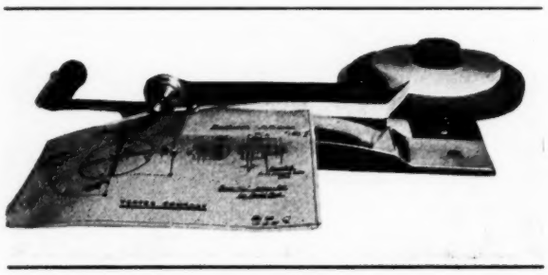


Federal Gage for Testing Hardness of Rubber, Cork, Felt, Etc.

Wrigraph Drafting Machine

A drafting machine, known as the Model R-300 Wrigraph, for making drawings up to 28 by 38 inches is being placed on the market by the Wrigraph Sales Division, 5201 Euclid Ave., Cleveland, Ohio. A mounting clamp enables the machine to be attached to any drawing board. The machine is self-leveling and has a permanently calibrated parallel mechanism.

The indicating protractor is of a new type, with which 1-degree angular settings can be easily made. The protractor can be clamped rigidly against rotation and has an automatic stop for the zero position. The Duralumin scales are interchangeable. The graduated drawing edges of these scales are made of a transparent pyralin. Regular equipment includes one 12-inch and one 18-inch scale with 1/16-inch graduations.



Vertex Binder for Applying Tape to Edges of Drawings

Binder for Applying Tape to Edges of Drawings

Edges of drawings. blueprints, photographs, data sheets, charts, and all kinds of valuable papers can be protected against tearing by the use of the Vertex taping machine here illustrated. This machine, made by the Vertex Co., 5 Great Jones St., New York City, is operated by simply turning a crank and feeding the sheet through the rollers.

Paper tape or transparent tape, the latter clear or colored, is applied to the edge of the paper or drawing. Curves or complete disks can be taped with equal facility. The machine will handle sheets as thin as tissue up to those 1/16 inch thick or several sheets of this combined thickness. If desired, the drawings can be bound between a sheet of cellophane and thick cardboard. The tape is about 1/2 inch wide, so that when folded and applied, it forms a border about 1/4 inch wide.

Seasoning Gray-Iron Castings by Heat-Treatment

It has been the time-honored custom to relieve the stresses in large castings by storing them for a considerable period of time —that is, to "season" them. Recently, heat-treatment methods have been developed whereby the seasoning is done in a comparatively short time in a furnace built for the purpose.

In the machine tool industry, the problem of seasoning was not a serious one when standard machines mainly were manufactured. During recent years, however, when so many special machines have been built, the seasoning of castings over a long period has become impracticable because it holds up delivery too long; hence accelerated seasoning has become necessary, resulting in the installation of so-called "normalizing" furnaces.

A large normalizing furnace was installed by the Landis Tool Co., Waynesboro, Pa., some time ago. The castings are placed in this furnace and left there for several days before machining. They are slowly heated to about 1200 degrees F. to relieve all stresses set up during the cooling of the casting in the foundry. This heat is held for about seven or eight hours, after which the castings are permitted to cool gradually over a period of twenty-four hours. Since the castings and the air surrounding them are heated to the same temperature, and this temperature is then steadily lowered throughout the furnace, no new stresses are set up within the casting when cooling; thus in a few days, all stresses are removed and the machine tables and beds so treated will hold their alignment permanently.

Experiments conducted at one of the university laboratories have demonstrated that a casting that has not been normalized or seasoned, but that is machined immediately after it has cooled down in the foundry, will show changes resulting from stresses for years afterward, whereas normalized castings of the same size, machined at the same time, show no changes.

Preparation of Catalogues

The Technical Publicity Association, Inc., has published a report entitled "Catalogue Practice and Procedure" which contains valuable information on the subject of catalogue-making. It defines different types of catalogues and directories, outlines the service that should be rendered by a catalogue, and tells how to proceed in preparing a catalogue to meet such needs. It also deals with catalogue distribution and with methods of preparing so-called "collective" catalogues. The report, covering sixteen letter-size mimeographed pages, is obtainable from the National Industrial Advertisers Association, Inc., 100 E. Ohio St., Chicago, Ill., at a price of $2.

* * *

The best government is that which enables men and women to stand permanently on their own feet—not the government which merely sustains them in a state of helplessness. We need self-reliance, not paternalism.